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Highway Bridge Approach Details

By Frank Barber*

It is too often the practice in highway bridge design to consider the bridge only between its abutments and to neglect the very important problems of the approaches, a proper solution of which contributes as much to the appearance of the bridge as any other factor. In his bridge work in Ontario the writer has had occasion to observe the following principles in approach design, most of which are exemplified in the accompanying views of the bridges as built.

Width of Approaches—Although it generally costs ten times as much to widen the floor of a steel or concrete bridge as to widen the earth approaches, a country bridge with 16-ft. roadway and approaches 12 or 14 ft. wide is a common sight. Sixteen feet clear between handrails is the usual width in Ontario for bridges carrying ordinary country traffic, because this is supposed to be the narrowest road on which two vehicles can conveniently pass. In the writer's opinion this is a popular error, because it may be observed that drivers, perhaps as a matter of preference, will not ordinarily pass on a 16-ft. bridge, though it must be admitted that it can be done. But why put extra money into widening a bridge when people will not generally use it for the purpose for which it was intended? It is therefore suggested that for small traffic 14 ft. should be the width adopted—nothing less will accommodate certain kinds of farm machinery—and where the bridge floor is to be made just wide enough for vehicles to pass easily it should be 18 ft. wide.

Fig. 1. Highway Bridge with Barrel Cut to Plane of Slope

(Illustrates arch with no wings at saving of 18% concrete over wings; also saving of concrete by using 1 : 1 slope dry wall instead of 1½ : 1 fill; span 26 ft., road 14 ft. to low water)

Easy Side Slopes—The reason that so many steep side slopes are seen is partly from lack of strict supervision. Doubtless in many cases cuts and fills are not laid out on the ground with slope stakes. Another reason may be due to false economy—the desire to lessen the quantity of earth required. However, very little saving in first cost results from scamping the earth by making steep fills. For a fill 100 ft. long and an average of 7½ ft. deep about 100 cu.yd. more of earth is required to make the proper slopes of 1½ horizontal to 1 vertical than to make slopes of 1 to 1, which is about the steepest that earth can be made to stand. The difference in cost is perhaps $35, and that will not go far in repairing 100 ft. of fill with steep side slopes.

It may be worth while to consider the advantages in certain cases of making the sides of fills with even easier slopes than 1½ to 1. It is found that when the slopes are made 3 to 1 no approach fences are needed (see Figs. 2 and 3) because vehicles may then be driven out on the slopes without danger of overturning. The difference in cost between the 3 to 1 slope and the regular 1½ to 1 for a fill 6 ft. high is about 20c. per lin. ft. each side, or about the same as the cost of a stout wooden approach fence. For a fill 12 ft. high the extra cost of the easier slope is about 80c. per lin.ft., or about the same as the cost of a good fence of concrete posts and 2-in. gaspipe railing. We may conclude that eliminating the fences by easy slopes is not feasible for high fills, but for low fills it is often the cheaper in first cost and results in handsomer and more permanent bridge approaches compared to steeper fills.

It is not economical to build a 3 to 1 slope close up to the abutments, on account of the length of the wing-walls required to retain it. Where recourse is had to easy slopes to save fences the slopes at the wing-walls should be 1½ to 1, gradually becoming less steep until a slope of 3 to 1 is attained at a distance of perhaps 20 ft. away from abutments.

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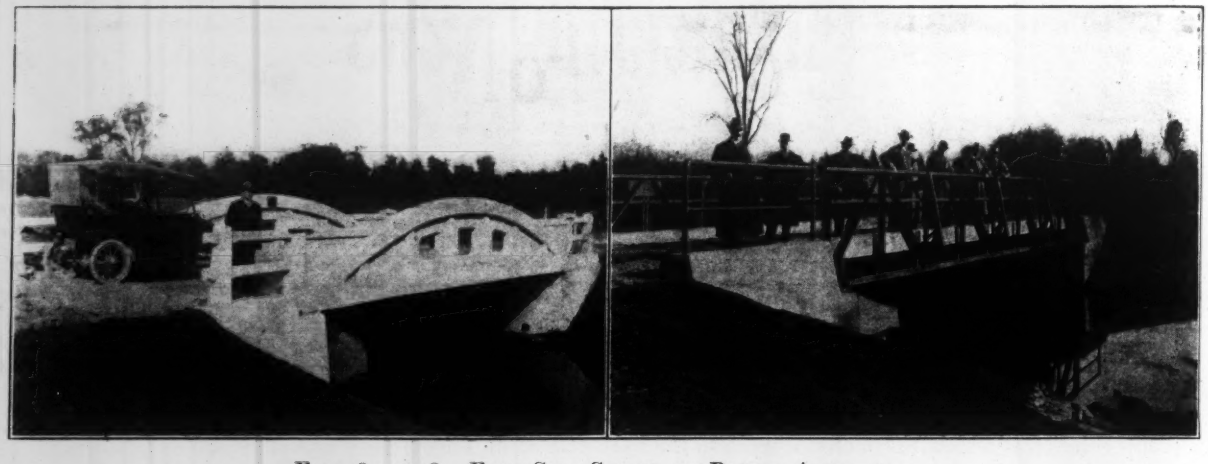

FIGS. 2 AND 3. EASY SIDE SLOPES ON BRIDGE APPROACHES

(3 : 1 sodded slopes; no approach fence required. Fig. 2, on left, Pegg's Bridge, York County, Ontario; span, 30 ft. Fig. 3, on right, Tool's Creek Bridge, York and Ontario Counties, Ontario; span, 40 ft.)

FENCES ON FILLS—Where fences are constructed on new fills each pair of posts should be wired together under the fill to prevent the fences from spreading and leaning as the fill settles. If concrete posts (Fig. 8) are used in order to prevent them from settling down with the new fill, each post should rest either upon the old earth bed or, where the new fill is too deep, upon a block of wood, which in turn rests upon the old bed. For this purpose it is convenient to allow the contractor to use timbers from the old bridge if there are any.

SODDING SLOPES—Bridge engineers are finding that it is often worth while to place old sod on the slopes of cuts and fills. If they are merely seeded the rain frequently forms large ruts before a good bottom is obtained, to say nothing of the fact that seeded slopes grow up ragged and contain unsightly weeds. Good old sod is the result of a survival of the fittest, and when slopes are surfaced by it they quickly become hard and permanent. On bridges designed by the writer sodding has cost an average of 9c. per sq.yd. To sod 100 ft. of fill an average of 8 ft. in height would thus cost less than $30, which is probably not more than the cost of repairs which would otherwise be required on a new fill of this size (see Figs. 2-5).

PAVED SLOPES—Good use is often made on bridge approaches of field or river stone used as drywall or neatly laid riprap for paved gutters to carry rain water down the sides of fills and for protective work to prevent scouring of fills by freshets. The specifications and inspection of a drywall to retain earth approaches should insure its being deeply founded and carefully laid on slopes not steeper than 1 to 1. Vertical or steep drywalls are probably not so permanent as good sod laid on easy slopes. It is perhaps worth mentioning that where the fill is completely surfaced next to the abutments with drywall on a slope of 1 to 1 there is about one-third less concrete in the wings than where they have to retain an earthfill at a slope of 1½ to 1. Where drywall or riprap is exposed to heavy freshets it may be advisable to pour thin concrete into the spaces between the stones after it is placed. The writer has found that in such cases about one-fourth of the bulk is concrete; for instance, in one case 28 cu.yd. of riprap required 7 cu.yd. of concrete to fill (see Figs. 4 and 5).

WING-WALLS—Judging by examples, especially in the older bridges, of unduly short wing-walls in connection with high fills, of masonry in wings rising much above the earth of the fill, of wings placed at uneconomical angles with the abutments, it is apparent that the function of wing-walls has not always been well understood in some localities. Their main function is, of course, to retain the approach fills, and the top of the wings should be built

FIGS. 4 AND 5. BRIDGE APPROACHES WITH SODDED BANKS AND RIPRAP PAVING

(Fig. 4, Wadsworth arch, Western Ontario; span, 118 ft. 6 in.; U-walls, 12 in. thick, with earth at same height inside and out. Fig. 5, Nicholson Bridge, Simcoe County, Ontario; span, 135 ft. Concrete fenceposts on approach)

to conform with the fill at all points of the slope, so that the concrete or masonry does not project above the fill at any place. It is the writer's belief that splay wings are most satisfactory when placed at an angle of 30° to the face of the abutments. It is true the wings would contain a smaller amount of concrete if they were placed in a straight line with the faces of the abutments so as to come out close to the edge of the stream, and such wings are quite proper for subways; but where water has to be contended with, straight wings are impracticable because of the danger of the water working around behind them. "Thirty-degree wings" contain 15% more concrete than straight wings, but the end of each 30° wing is brought a distance equal to one-half the length of the wing behind the face of the abutment, and presumably that distance away from the edge of the stream, so that there should be no danger of a washout behind the wings.

FIGS. 6 AND 7. WING-WALLS VERSUS OPEN APPROACHES
(On left, Highland Creek Bridge, York County, Ontario; span, 60 ft.; cost, $9500. On right, Pratt Bridge, York Township, Ontario; span, 50 ft.; cost, $5200)

FIG. 8. FREEMAN'S BRIDGE, ONTARIO
(Clear span, 91 ft.; illustrates proper slope for drywall and concrete approach fences)

However, when the ends of the wings are placed still farther back from the stream the increased amount of masonry required is very noticeable. For instance, wings at an angle of 45° with the face of the abutment will contain about 22% more concrete or masonry than wings at an angle of 30°. U-wings, the principle of which is quite different from that of splay wings, should nearly always be used with arch bridges, and are often the most economical in other situations. Since wing-walls, of whatever kind, increase in length and cost as the height of the fill to be retained increases, it is better not to attempt to retain a high fill at all but to let it take its natural slope on all sides. In this case shore spans and piers are used instead of abutments and wings. The higher the fill, the more economical are shore spans compared to wing-walls.

Sometimes shore spans are economical for fills 20 ft. high and nearly always for fills 25 ft. in height and greater. The Angus Bridge in Simcoe County is an example. Here the floor is 20 ft. from summer water level. Tenders were called for on the substructure for two designs, one being the ordinary abutments with splay wings and the other concrete shore spans and piers. The lowest tender was for shore spans and was $500 cheaper than for the wing-wall design.

The views in Figs. 6 and 7 illustrate this principle. Fig. 6 shows the Highland Creek Bridge in York County, which is of 60-ft. span and 30 ft. high. It is a steel deck span (recently concreted) between high U-abutments, which are expensive and obstruct the stream. It cost $9500. Fig. 7 illustrates the Pratt Bridge in York Township, which is of 50-ft. span and 30 ft. high. It is a concrete girder bridge with open approaches, allowing free waterway. It cost $5200.

STREAM BED—While not strictly a subhead under the title of this article, the treatment of stream beds is worthy a paragraph here. Clay, gravel and boulders between the abutments and underneath the superstructure are often heaped up either by nature or otherwise so high as to rise considerably above the surface of low water. This of course hampers the waterway at the time of freshets. If it is said that extra waterway may not be required in these cases to take care of freshets, the answer is that if this material had been cleaned away perhaps shorter spans might have been used. It is cheaper to provide sufficient waterway by cleaning out this material than by increasing the span of the bridge.

Water-Purification Results at Cincinnati in 1914

A number of tabular summaries of the analytical results of water treatment at Cincinnati, Ohio, for the year 1914 are here reprinted. The tables are from an advance copy of the forthcoming annual report of J. W. Ellms, Superintendent of Filtration. They are made up, Mr. Ellms informs us, "very largely along the lines recommended by the committee of the New England Water Works Association on uniformity of records for water-purification plants." (See ENGINEERING NEWS, Mar. 25, 1915, p. 576, for Philadelphia statistics along the same lines.)

The water-supply of Cincinnati is drawn from the Ohio River, settled in reservoirs of large capacity, coagulated with sulphate of iron and lime and passed through mechanical filters. The quantities treated in 1914 and various other data, including those given below in more detail, were summarized in our issue of May 6, 1915.

TABLE I—AVERAGE TURBIDITIES OF RIVER, SETTLED AND APPLIED WATER, AND PERCENTAGES OF REMOVAL
(Parts per Million)

Month	Turbidities: River	Settled	Applied	Percentage Removed by: Sedimentation	Coagulation	Filtration
January	95	37	13	61.05	25.26	13.69
February ...	235	78	13	66.80	27.66	5.54
March	145	50	11	65.51	26.90	7.59
April	155	46	13	70.32	21.29	8.39
May	140	40	11	71.43	20.71	7.86
June	11	5	4	54.55	9.09	36.36
July	17	7	5	58.82	11.76	29.42
August	145	20	8	86.21	8.28	5.51
September ..	100	29	6	71.00	23.00	6.00
October	70	13	7	81.43	8.57	10.00
November ..	9	5	3	44.44	22.22	33.34
December ..	300	40	9	86.70	10.30	3.00
Average..	120	31	5	74.16	21.67	4.17

TABLE II—AVERAGE MONTHLY BACTERIAL COUNTS AND PERCENTAGES REMOVED
(Bacteria per c.c.)

Month	River	Settled	Applied	Filtered	Monthly Efficiency, per Cent.*
January	51,710	11,130	2,110	26†	99.95
February ...	53,820	12,070	2,250	87†	99.84
March	37,000	11,240	1,190	39†	99.89
April	11,420	3,650	570	13†	99.89
May	4,760	780	210	22†	99.54
June	380	87	62	25	93.42
July	420	90	80	22	94.76
August	2,750	190	75	8	99.71
September ..	1,240	200	60	8	99.35
October	2,480	170	75	12	99.51
November ..	230	115	100	46	80.00
December ...	31,720	3,100	480	120	99.62
Average..	16,500	3,570	670	36	....

*The yearly efficiency, based on the number of bacteria found in the filtered water, was a removal of 99.78% of the number present in the river water.

†Liquid chlorine was applied from Jan. 1 to May 27.

TABLE III—SUMMARY OF TESTS MADE FOR BACILLUS COLI
(Water Quantities Expressed in c.c.)

	River Water			Settled Water			Filtered Water		
Presumptive tests	0.01	0.1	1.0	0.1	1.0	3.0	1.0	20.0	100.0
Lactose bile medium									
No. of tests..	365	365	365	365	365	365	365	365	1095
Per cent. positive....	10.68	46.57	89.86	15.07	58.63	84.93	1.09	19.45	51.05

Positive presumptive tests of 1 c.c. samples were confirmed in the usual way; all the results of other tests are presumptive, and were obtained with lactose bile.

From Jan. 1 to May 27, 438 samples of filtered water showed 92.69% of tests to be positive in 100 c.c. before disinfection and 23.97% positive in 100 c.c. after disinfection.

TABLE IV—EFFECT OF CHLORINE DISINFECTION ON BACTERIA*

Month	Bacteria per c.c. Before	After	Per cent. Positive B. Coli 1.0 c.c. Before	After	20.0 c.c. Before	After	100.0 c.c. Before	After
January ..	300	26	3.23	0.00	58.06	3.23	94.62	16.13
February .	370	87	0.00	0.00	57.14	3.57	94.05	33.33
March	305	39	0.00	0.00	12.90	0.00	77.53	3.23
April	80	13	16.67	0.00	83.33	0.00	97.78	7.78
May	75	22	14.81	0.00	70.37	18.52	100.00	55.55
Average.	226	37	6.94	0.00	56.36	5.06	92.80	23.20

Percentage removal of bacteria by disinfection, 83.63.

*Chlorine applied at the rate of 0.1 part per million from Jan. 1 to May 27.

Small Locomotives for Construction and Industrial Service

Locomotives of small size and light weight are frequently required for the operation of narrow-gage construction railways and industrial-railway systems. Two locomotives of this class are described below.

In Fig. 1 is shown a special type of geared locomotive having a high-pressure vertical tubular boiler and using liquid fuel. The cylinders are placed between the axles and drive a crankshaft carrying a pinion which engages a spur gear on the forward axle. Coupling rods connect the two axles. The gear ratio is from 1 : 1¾ to 1 : 2, according to the requirements of different engines The machinery is mounted in the truck frame, and above this is a separate frame carrying the boiler, fuel and water

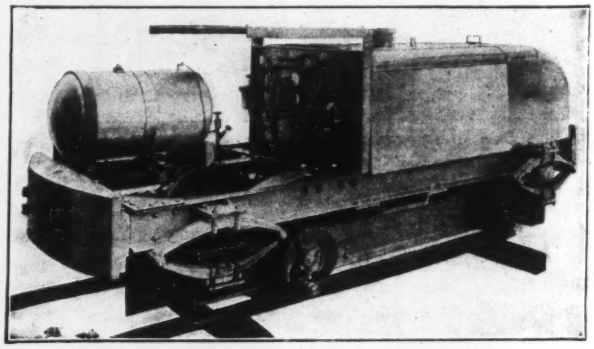

FIG. 1. A CONTRACTOR'S GEARED LOCOMOTIVE, WITH HIGH-PRESSURE TUBULAR BOILER AND LIQUID FUEL

tanks, etc. Long elliptical springs are placed between the frames to make the machine ride easily on rough and irregular track. Roller bearings are used for the crankshaft and connecting-rods, and the eccentrics also have anti-friction bearings.

The engine is of the horizontal type, with two cylinders, plain slide valves and link reversing gear. The cylinders rise and fall with the movement of the truck frame on its springs, but the crankshaft and axle are maintained in permanent relation, so that the gears remain always in proper mesh, the engine and crankshaft moving radially to the axle. The gearing runs in an oil bath. For repair or overhauling, the engine can be removed bodily and sent to the shop. Hand brakes are fitted, but steam or air brakes can be added if desired.

The fuel is delivered by gravity or forced feed, as may be required, and is atomized by a steam jet. The engine can use crude oil, distillate or gasoline, the last being employed in tunnel work on account of the heavy fumes from the oil. The steam exhaust is delivered to the smokestack in the usual way.

The boiler is a special feature of the machine. It is designed for 600-lb. pressure, but the ordinary working pressure is 250 lb. The shell and lower head are made of one piece of pressed steel, and the upper head is welded to the shell. The shell is reinforced by a ring welded around each end and by a wrapping of three layers of piano wire. The tubes are of copper, ½-in. diameter, expanded into the heads and reinforced at the ends with steel thimbles. For the boilers of 5-ton engines there are 99 tubes, giving 156 sq.ft. of heating surface. These

boilers have been tested to 2200 lb. by hydraulic pressure without failure, and the tubes have carried 1200 lb. before showing leakage. A fusible plug is so placed as to blow out when there is still 3½ in. of water in the boiler.

The locomotives are built in only three sizes, weighing

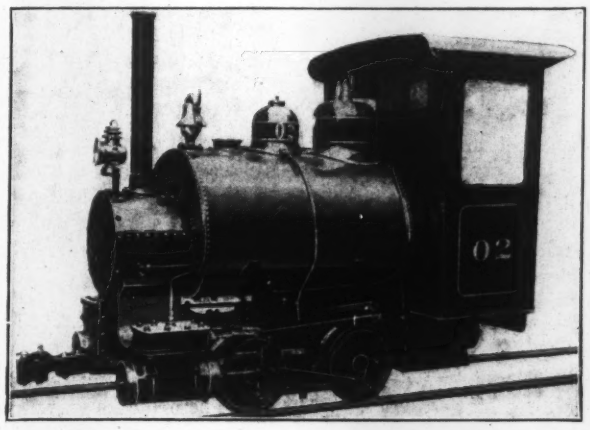

FIG. 2. 5-TON LOCOMOTIVE FOR AN INDUSTRIAL RAILWAY OF 2-FT. GAGE

3, 4 and 5 tons in working order, but they are made for any desired gage of track (minimum, 24 in.). The dimensions of the 3-ton engine are about as given in the following table:

Cylinders (2)	4x5 in.
Driving wheels (4)	18 in.
Wheelbase	4 ft. 2 in.
Length over all	11 ft.
Height (4 ft. with cab)	3 ft. 8 in.
Boiler, diameter	23 in.
Boiler, height	14 in.
Tubes, ½-in.	751
Heating surface	104 sq.ft.
Fuel tank	40 gal.
Water tank	60 gal.
Speed, maximum	15 to 20 m.p.h.
Curves, sharpest radius	16 ft.

These locomotives are built by the Bell Locomotive Works, 66 Myrtle Ave., Flushing, N. Y. They have been used during the past three years in some of the tunnels for the Catskill aqueduct (New York water-supply), on the Lexington Ave. subway in New York, and on sugar plantation work. The one in work in the subway is shown in Fig. 3.

FIVE-TON LOCOMOTIVE OF 24-IN. GAGE

In the construction of the new plant of the Baldwin Locomotive Works at Eddystone, Penn., an interesting feature was the use of a very small steam locomotive, and this engine has since been employed in operating the industrial-railway system at that plant. It was built by the company for its own use, but similar engines have been built for other work. It is a four-wheel saddle-tank engine, as shown in Fig. 2, and weighs only 11,700 lb. The railway is of 2-ft. gage, with curves of 16-ft. radius.

The engine is of ordinary design, in miniature, but the cylinders have a rather long stroke in proportion to their diameter. Plain slide valves are used, with the Wiener radial valve-gear. This gear is operated from a return crank on the main crankpin, with a vertical lever connected to a radius rod and having the valve rod attached to it. The Baldwin steam brake is applied to all the wheels, and at each end is a radial drawbar with automatic coupler.

The main dimensions of the engine are given in the following table:

Wheels (4)	1 ft. 8 in.
Journals	3¼ x5 in.
Wheelbase	2 ft. 6 in.
Weight in working order	11,700 lb.
Cylinders	5x10 in.
Boiler diameter	2 ft. 0 in.
Boiler pressure	150 lb.
Firebox (radial stay), size	18x27 in.
Firebox, depth	2 ft. 1½ in.
Water spaces	1¾ and 2 in.
Tubes, length	4 ft. 7 in.
Heating surface, tubes	81.6 sq.ft.
Heating surface, firebox	14.4 sq.ft.
Heating surface, total	96.0 sq.ft.
Grate area	3.4 sq.ft.
Water in saddle tank	100 gal.
Fuel	Hard coal
Tractive force	1600 lb.

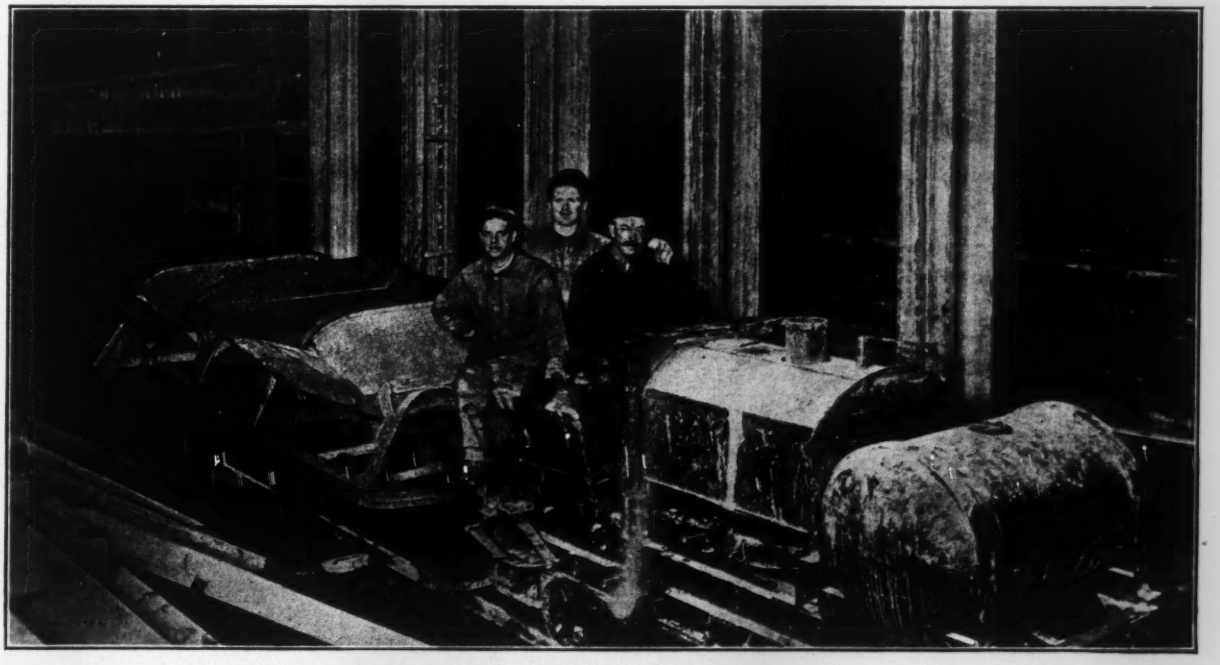

FIG. 3. CONTRACTOR'S OIL-FUEL LOCOMOTIVE IN THE LEXINGTON AVE. SUBWAY, NEW YORK

Kensico Dam Construction in 1914

By Wilson Fitch Smith*

SYNOPSIS—Kensico Dam, just north of the city limits of New York, is one of the largest masonry dams in the world. With an admirable plant and novel methods the construction has proceeded at record speed. The progress during the working season of 1914, which marked the practical completion of the dam proper, is recorded in this article. [With folding insert.]

The remarkable progress in the construction of Kensico Dam during the year 1913, when 316,000 cu.yd. of masonry was placed in 200 working days (Engineering News, May 21, 1914, p. 1105), was greatly exceeded during the year 1914, when 489,750 cu.yd. was placed in 221½ working days of 8 hr. each, or an average of 2211 cu.yd. per day for the entire season. This achievement is a record in dam construction and is believed to be the greatest mass of masonry ever placed in a single structure in the same length of time.

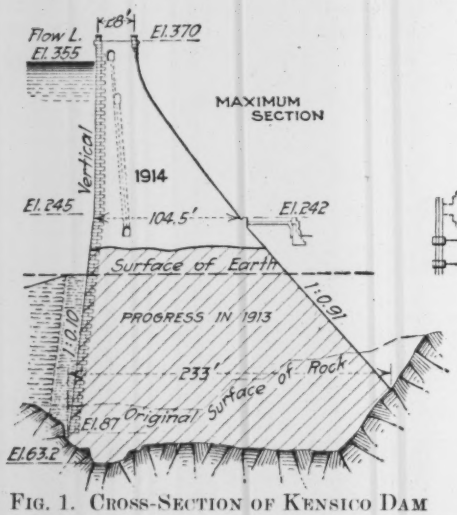

Fig. 1. Cross-Section of Kensico Dam

The method and the plant arrangement by which this herculean task was accomplished are somewhat of a departure from the usual methods recently employed in the construction of large masonry dams. Instead of delivering the concrete and other materials to the derricks on the dam by cableways, which are limited in speed, the materials were all brought to the derricks by rail. In place of the usual central concrete plant containing all the mixer units, there were several mixing plants located at convenient points, reducing to a minimum the distance over which the mixed concrete was carried. Instead of individual stiff-leg derricks that would necessitate frequent moving, the bulk of the masonry was placed by large derricks, equipped with 57-ft. booms and double-speed hoists, mounted in pairs on travelers which operated over elevated tracks carried on piers of masonry. These piers were included in the masonry of the dam as it was built up around them and became integral parts of the structure. This general arrangement of plant was supplemented by careful attention to all details and a very efficient organization. The transverse contraction joints which divide the dam into independent sections about 80 ft. long were another feature which added greatly to the facility of construction, enabling the building of any section to any convenient height independent of the adjoining sections.

The elevated traveler tracks were used for the central portion of the dam between the sloping hillsides, and except the top lift all masonry between joints 5 and 17, a length of 943 ft., was placed by the traveler derricks. Beyond these limits the ends against the sloping hillsides were placed by guy derricks with 90-ft. booms.

The upstream face and the faces of the contraction joints were laid up with concrete blocks manufactured in a special yard for that purpose. (See Engineering News, May 7, 1914, p. 1020.) These blocks served as forms for the cyclopean concrete. The downstream face was built against wooden forms anchored into the masonry with galvanized steel wire. Above the elevation of refill the downstream side was built in steps corresponding with the bed-joints of the facing masonry, which will be laid up on these steps and backed with concrete this coming season.

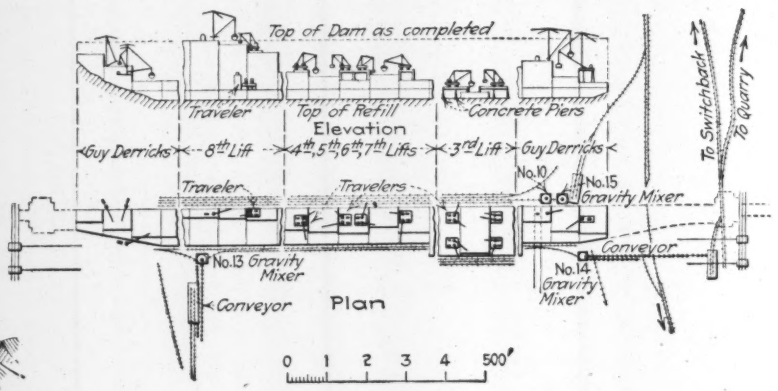

Fig. 2. Typical Arrangement of Plant at Kensico Dam

All of the plant at the dam, excepting locomotives, is electrically operated by alternating current furnished by the New York Edison Co. over a high-tension power line at 45,000 volts located along the aqueduct right-of-way from Yonkers. Electricity is also used for operating the crushing plant at the quarries and the air compressors which furnish the air for the quarry drills and stone-dressing machines.

At the close of the season of 1913, Kensico Dam had reached the elevation of 214.5 for a length of 859 ft. The average depth of masonry below this plane was 50 ft. and the maximum was 151 ft. During the winter of 1913-14 the refill was placed on both sides of the dam to the level of the completed masonry. The excavation was extended on both ends, the concrete plants rebuilt in new locations and the track system rearranged.

Three concrete mixers of the Hains-Weaver gravity type were located in special structures—two on the down-

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FIG. 3. DOWNSTREAM FACE OF KENSICO DAM FROM WEST HILL
(Fifth lift in progress; concrete plant in foreground)

stream side of the dam at the foot of the east and west hills and one on the upstream side at the foot of the east hill. On the top of each plant were bins for aggregates, which were supplied by belt conveyors drawing from storage bins on the hillsides. The cement cars were run directly to each mixer and the bags conveyed from the cars to the gaging platform by belts (Fig. 3).

The placing of masonry was resumed on Mar. 17 in the low section at the west end. By Mar. 30 the rearrangement of plant was completed, and work was begun on the third lift in the central portion. Two parallel tracks, supported on concrete piers 25 ft. high, carried the travelers. (See Fig. 6 on insert sheet.) Each group of four travelers covered a section, two travelers on each track facing each other on opposite sides of the section. Two service tracks laid on the refill on each side of the dam brought the materials to the nearest derricks. During the busy part of the season 16 traveler derricks and 6 guy derricks, 3 at each end, were engaged in the placing of masonry. The concrete was brought from the mixers in bottom-dumping buckets of 2 cu.yd. capacity, on flatcars operated by steam hoisting engines carried on one end of the car and coupled to an axle by a chain-and-sprocket gear; usually there were two shuttle cars to each mixer, each car carrying two buckets. The cyclopean stone was brought from the quarry, about one mile away, in eight-car trains, each car carrying about 25 tons.

The concrete blocks forming the upstream face and the faces of the contraction joints were laid at night, one course 2½ ft. high being the limit of the following day's concrete work. After a section was completed to the base of the traveler tracks the travelers were moved to the next section. As soon as a considerable portion of the lift was completed the piers for the fourth lift were built and the track erected. The width of the dam at the top of the fourth lift, El. 264.5, being only 84 ft., a single traveler track was erected, and instead of the pyramidal concrete piers two 10-ft. sections of the contraction-joint facing blocks were built to support the traveler-track girders, the projecting ends of the header blocks being supported by concrete slabs or filler blocks laid with mortar joints (Fig. 7, on insert). The ends of the girders between

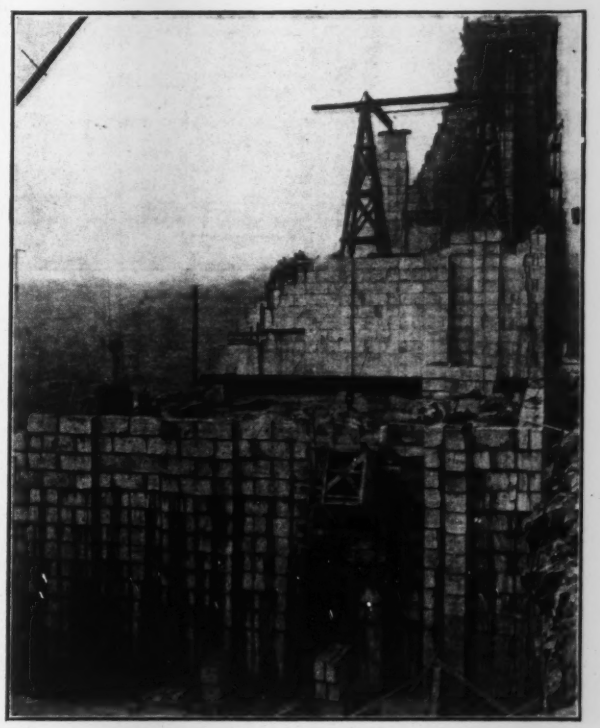

FIG. 4. EAST END OF KENSICO DAM
(Construction of Section 18 in foreground. Section 16 is finished to top of dam. Note the two inspection galleries)

the joints were supported on removable timber towers. This change proved very favorable, as the timber tower and tracks could be entirely removed from the section and the block piers were more easily erected than the concrete piers. Each traveler, after being lightened by the removal of the engines and booms, was lifted to the new tracks by the cableways, assisted by the companion traveler. After the third lift was finished the downstream service tracks were located at the level of the bench left for the footing of the dimension stone facing, the outside track being carried on the outer line of third lift piers which projected beyond the sloping face of the dam. From then on, these tracks were used only for concrete from the two downstream mixers. All of the cyclopean stone, blocks and the concrete from the upstream mixer were delivered on the upstream tracks. In the fourth and succeeding lifts two facing travelers covered a section, and four sections were in progress at once.

At the fifth lift, El. 289.5, the booms of the downstream derricks were lengthened 10 ft., which enabled them to reach the service tracks on this and the succeeding lifts. The same system was used for the sixth lift, El. 314.5, and the seventh lift, El. 339.5. The eighth lift, 30 ft. high, brought the masonry to El. 369.5, the subgrade of the roadway on top of the dam, and was built by the travelers carried on the top of the seventh lift. After one section had been completed the travelers were moved back and the succeeding sections were built with one traveler and a guy derrick mounted on the top of the dam (Fig. 5).

In the upper lifts two courses of facing blocks were laid up at a time, enabling a corresponding depth of concrete to be placed in a day, and in the top lift three courses of blocks were laid at a time for the same reason, the projecting headers being supported with filler blocks.

The concrete was mixed in 8-bag batches, which made about 52 cu.ft. of loose 1:3:6 concrete in the buckets.

Early in the season it was apparent that the only limit to the daily amount of masonry placed was the time required to fill the gaging pans and discharge the hoppers. By placing extra men to handle cement and offering a bonus for the best performance, the mixer output was increased until the maximum of 653 batches in 8 hr. was attained in one mixer. This is equivalent to 141 cu.yd. in place per hour.

Progress Record

The following table shows the monthly progress and the totals for the year:

Month.	Days (8 hr.)	Cyclopean Masonry, cu.yd.	Concrete Blocks, cu.yd.	Mass Concrete, cu.yd.	Total, cu.yd.
March	7	3,630	.....	10	3,040
April	27	47,940	4,130	500	52,570
May	24	60,760	3,780	750	65,290
June	26½	70,810	5,370	790	76,970
July	26½	62,570	5,710	1270	69,550
August	26½	76,130	7,810	510	84,450
September	27	56,920	8,000	300	65,220
October	25	35,060	5,890	1030	41,980
November	25	22,490	4,390	400	27,280
December	7	2,820	490	90	3,400
Total	221½	438,530	45,570	5650	489,750

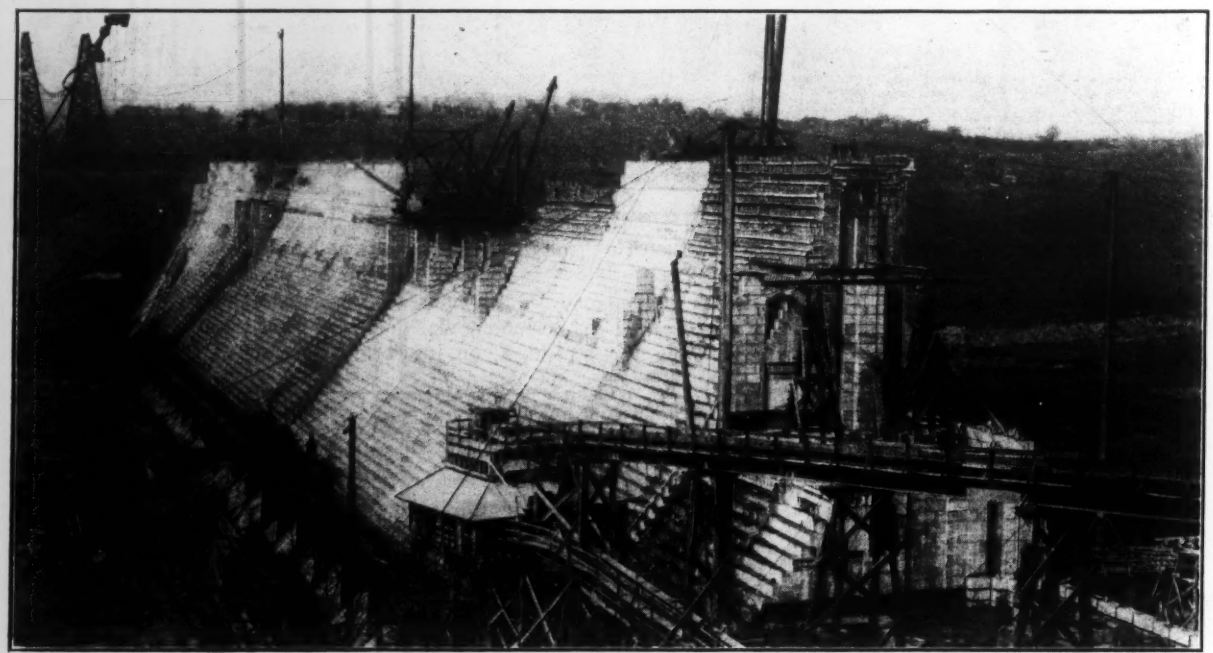

Fig. 5. Downstream Face of Kensico Dam from East Hill
(Construction of eighth lift)

The best month's work was in August, when a total of 84,450 cu.yd. of masonry of all classes was placed in the fifth and sixth lifts in 26½ 8-hr. days. Above the sixth lift the rapidly narrowing section of the dam limited the daily amount of masonry placed.

Excluding the dimension stone facing, 92% of the dam is completed. The work of the coming season will include the completion of the concrete, placing the facing masonry, building the terrace, pools, fountains, pavilions, drives and other architectural features.

Personnel

The dam is being built by the Board of Water Supply of City of New York to form the Kensico Reservoir, a part of the Catskill water-supply system. H. S. Kerbaugh, Inc., is the contractor, for whom Beverly R. Value is Chief Engineer and George H. Angell is Superintendent.

Water-Supply and Typhoid Fever at Cumberland, Md.

By Arthur G. Fowler* and Max J. Colton†

SYNOPSIS—Abandoning the polluted Potomac and securing a filtered, chlorinated water-supply from a sparsely populated drainage area, subjected to sanitary inspection, has, in conjunction with a reorganized health department, reduced typhoid from a high to a low figure.

Cumberland, Md., has just begun to realize the sanitary value of pure water. From 1871 to Sept. 15, 1913, the city was served with water taken from the Potomac River. When the system was first installed the supply was good, but the growth of population and manufacturing above the intake finally rendered the water unfit for use. The increasing number of deaths from typhoid fever convinced the people that something must be done to obtain a safe water-supply.

It was decided that the best possible supply could be obtained from Evitts Creek. An impounding reservoir being necessary, a site was selected two miles from the Maryland line in Pennsylvania, where a dam 80 ft. high, having a spillway 150 ft. long, would flood an area of 175 acres and store 1,800,000,000 gal. (Fig. 1 is a view of the dam and filter plant.)

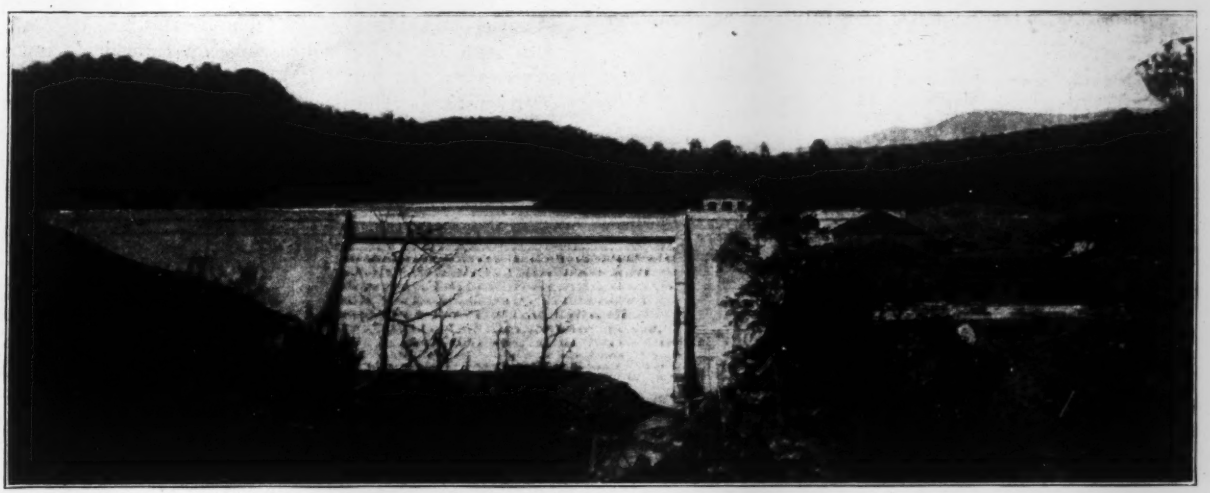

Fig. 1. Impounding Dam and Filtration Plant, Cumberland Water-Works

The total cost of the entire system, including the dam, a filter plant, a nine-mile pipe line and distributing reservoir in the city, with land, right-of-way, roads, etc., was about $600,000. Bonds for the work were sold, and work was started in December, 1911. In September, 1913, the new water was sent into the city mains.

The drainage area of Lake Gordon, as the impounding reservoir is called, is 66 sq.mi., and the territory is a farming country containing about 1200 inhabitants. A monthly sanitary inspection of the drainage area is made, checking every property within the area and noting its condition on forms prepared for the purpose. These blanks are forwarded to the Pennsylvania State Department of Health, and in cases where pollution is found such action as may be necessary is taken by that body. It is a pleasure to note that only a few cases have been observed where real pollution existed and that these have been remedied almost immediately.

Water is taken from the lake through either of two 30-in. gates, at El. 940 and 920. The water passes through two sets of fine screens that hold back leaves and sticks, and is then carried through a 36-in. pipe to the filter plant.

On entering the plant, the water is treated with hypochlorite of lime at the rate of 5 lb. to the million gallons and sulphate of alumina in such quantities as may be necessary to take care of changes in color and turbidity. The water then passes to six gravity mechanical filters, having a total area of 0.00813 acre. From the bottom upward there is first a 4-in. layer of ¼- to ¾-in. gravel, then 3 in. of fine gravel or sand and, last, 5 ft. of anthracite coal of such size that the particles will pass through a screen having six meshes to the inch.

The filtered water is discharged into a clear-water basin, from which it flows by gravity through nine miles of 36-in. wood-stave pipe to the distribution reservoir in Cumberland.

The designing engineer for the new supply was James H. Fuertes, New York City.

Typhoid Fever Statistics

As far back as available records go, the typhoid-fever rate of Cumberland has been far above the average of other cities. The table given on p. 970 shows the number of typhoid cases during the last 15 years. Fig. 2 shows the monthly distribution of cases during the past four years.

Public-health administration in Cumberland prior to June, 1910, amounted to practically nothing. The old

*Superintendent Filtration Plant, Cumberland, Md.
†Health Officer, Cumberland, Md.

form of government consisted of 11 councilmen and a mayor. The board of health was composed of four members and a combined secretary and health officer, who was a practicing physician drawing a nominal salary.

TYPHOID CASES, 1900-1914, AT CUMBERLAND, MD.

Year	Population (Est. as of July 1, Except Census Years)	Number of Cases	Case Rate per 1000 Population
1900	17,128	70*	4.08
1901	17,562	150*	8.54
1902	17,996	59*	3.28
1903	18,430	126*	6.83
1904	18,864	Records not available	
1905	19,298	Records not available	
1906	19,732	Records not available	
1907	20,166	26*	1.28
1908	20,600	64*	3.10
1909	21,034	115*	5.47
1910	21,839	568†	26.01
1911	22,340	359	16.02
1912	22,841	177	7.74
1913	23,342	472	20.26
1914	25,054	61‡	2.43

*All cases not reported.

†The increase in 1910 was due to the more complete reporting of cases which followed the appointment of a full-time health officer.

‡New water-supply in use during the year. On Apr. 1, 1914, new territory was annexed to Cumberland, known as South Cumberland. This district, with a population at that time of 1208, derives its water-supply to a very large extent from wells, pumps and cisterns, many of them located in the rear of yards or on the street. The usual privy vault exists on all premises. It is worthy of note, however, that only five cases of typhoid fever occurred in the new annexed district during 1914. These cases are included in the total number given for that year.

With the adoption of the commission form of government in April, 1910, a Department of Health was created, and under the guidance of a full-time health officer

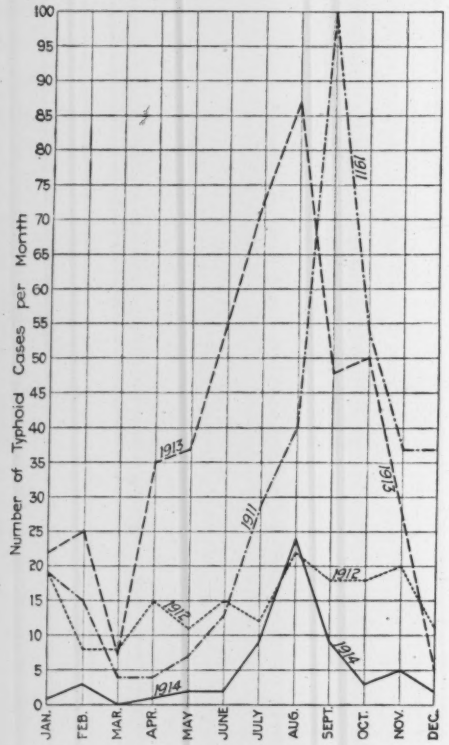

FIG. 2. TYPHOID FEVER BY MONTHS AT CUMBERLAND, MD., 1911-14

the department was organized in June of that year. An office and laboratory were established, and suitable and efficient steps were immediately taken to prevent the spread of disease.

In the first annual report of the Department of Health the health officer speaks of the difficulties encountered in bringing about results:

> Our water-supply has been of the worst. The city service as well as the wells and springs are badly contaminated. Our sewer system has been anything but the best. The milk supply of the city is unrestricted and practically uninspected.

Notwithstanding all of these unfavorable conditions the prevalence of typhoid fever was reduced to 359 cases in 1911, a diminution of 209 cases over the preceding year.

During 1912 a still further reduction was made. In that year many premises where privy vaults had formerly existed were connected with sewers, and prophylactic measures taken at the bedside of patients helped to bring about a reduction of 182 cases over 1911.

In 1913 there was a sudden high increase in this disease. After the local authorities had tried to curb the typhoid-fever epidemic the aid of the United States Public Health Service was requested, and Surgeon L. L. Lumsden and Passed Assistant Surgeon Hugh DeValin were detailed to determine the sources and modes of spread of typhoid infection. Their investigation lasted from Sept. 15 to Oct. 23 and followed well-known lines. Surgeon Lumsden advised the closing of all wells and springs in the city except those proved by the health department to be "free from evidence of dangerous pollution"; the collection and disposal of stable manure in a sanitary manner; an adequate force of sanitary inspectors; sanitary control of all water-closets and privies; and proper investigation and control of all typhoid cases.*

On Sept. 15, 1913, before Surgeon Lumsden's report was presented, the new Evitts Creek water was turned into the city mains. The decrease in typhoid fever was immediately noticeable in November, and at the close of the year the case rate was almost down to normal—lower than it had been for several years during the same period of time.

The year 1914 closed with 61 cases of typhoid, a most remarkable reduction over the preceding years and a reduction of 411 cases over 1913. With the plans under way at the present time for the material enlargement of the health-department force, the number of cases will doubtless be still further reduced during the coming years.

Of the typhoid cases for 1914, 26 patients had been out of the city on either a short or an extended visit a month prior to becoming ill, and many of these visits were to communities where typhoid fever was known to flourish. Thirteen others used water other than the public supply, secured from wells, pumps and cisterns within the city, and five cases were patients residing in the new South Cumberland annexation. This leaves only 17 cases where the infection was supposedly due to conditions in Cumberland.

Finally, the general death rate has been steadily reduced from 19.05 in 1910 to 13.45 in 1914.

⁂

Road Construction in Northern Ontario—Plans now completed by the Ontario Government for extensive road construction in northhern Ontario contemplate the expenditure this season of $615,000 upon the work. The sum of $90,000 will be devoted to a highway along the route of the Timiskaming & Northern Ontario Ry. and $75,000 for a road along the Transcontinental Ry. A trunk road will be constructed from Sturgeon Falls to Sudbury. Apportionments for road-building are also made to various districts as follows: Rainy River, $35,000; Kenora, $25,000; Port Arthur, $40,000; Fort William, $50,000; Sault Ste. Marie, $50,000; Sudbury, $40,000; North Bay, $50,000; Nipissing, $35,000; Haileyburg and South Lorrain, $55,000; other roads, $102,000.

*Copies of the official report on this investigation may be obtained from the Department of Health, Cumberland, Md.

Design of Steel Elevated Railways, N.Y. Rapid Transit System

By Maurice E. Griest*

SYNOPSIS—Detail account of reasons for the general type and the arrangement of main parts adopted in the new steel elevated-railway structures in the new New York rapid-transit system. Deck plate-girder construction; two-column transverse bents; track stringers between column-and-girder bents; spans average 50 ft.; expansion at alternate bents; provision for longitudinal forces; column made of I-beam and two channels.

The new rapid-transit lines now under construction in New York City include 144 miles of subway and 106 miles of elevated track to be built by the city, and also third-tracking and extensions of their present elevated lines by the operating companies totaling 67 miles of track. Plans for the city-built lines are made by the Public Service Commission, while plans for the extensions of the present elevated lines are being made by the companies subject to the approval of the commission. In this paper some features of the design of the city-built elevated lines will be considered.

Open-Floor or Solid-Floor Construction

A subway is preferable to an elevated line from the standpoint of the property owners along the route, and a general policy of not constructing elevated lines in the central congested districts has been followed. On the other hand, the cost of a subway is so great that, with the city's present financial condition, a universal subway system is out of the question. The program therefore provides trunk-line subways through the central districts of Manhattan and Brooklyn, with elevated feeders in the outlying districts.

When the Triborough system was under consideration in 1910 it was proposed to build elevated extensions or feeders with ballasted track on a solid concrete floor to reduce the noise to a minimum, thereby reducing somewhat the objections to the elevated lines. When the present dual-system contracts were prepared the city's financial condition made it imperative that the feeders be built as cheaply as possible. The relative cost of subway and elevated lines with ballasted floor and with open floor for the 106 miles of proposed elevated tracks are as follows:

COST OF SUBWAY AND ELEVATED STRUCTURE

		Per Lin. Ft. of Structure	Total
Three-track subway		$300 to $500	$63,000,000 to 105,000,000
Three-track elevated	Solid floor.	$200	42,000,000
	Open floor.	125	26,000,000

The open-floor construction would cost about $16,000,000 less than the solid-floor and from $37,000,000 to $69,000,000 less than the subway. It is therefore evident why open-floor elevated construction was used for the feeders in outlying districts.

Type of Bent

The elevated lines consist largely of a three-track construction, providing two tracks for local service and a center track for rush-hour express service in the direction of the maximum traffic (returning the express trains empty over the local track). In general a two-column bent was found to be most satisfactory and most economical; it has been adopted uniformly except in special cases, such as at stations, where the structure is widened to such an extent that three or four columns are necessary.

Columns in Roadway

With the two-column bent there are in general two practicable positions for the columns, namely, in the roadway and on the sidewalk near the curb. As any obstruction in the roadway is always a source of danger to traffic, it is desirable to keep the roadway clear of columns as far as possible. On the other hand, in wide streets a material saving in cost is effected by placing the columns in the roadway. Furthermore, the appearance is largely improved by eliminating wherever possible the long transverse girders projecting beyond the longitudinal stringers. The cost, appearance and obstruction to street traffic were therefore factors in determining the column location. The widths of roadway for various street widths have been fixed by resolution of the Board of Estimate and Apportionment as follows:

Street width, feet	100	80	70	60
Roadway width, feet	60	44	36	30

With a 60-ft. roadway it was not considered practicable to place the columns on the sidewalk, as the cross-girders would be over 63 ft. long and would project 16.5 ft. on each side beyond the outside longitudinal stringer. With columns in the roadway the exact location was determined by their relation to the longitudinal stringer (affecting the strength, rigidity, appearance and cost of the structure), to surface-car tracks, and to the lines of vehicular traffic.

Structurally it is desirable to place the columns under the outside stringer. With this construction, longitudinal curved brackets can be placed advantageously on the column under the stringer, thus reducing the unsupported length of column, increasing the rigidity of the structure and producing a pleasing appearance. By placing the columns between the stringers of the outside tracks the section of the cross-girder is reduced slightly and the section of the column increased correspondingly, as longitudinal brackets are not feasible with this construction. The brackets increase the cost by $1 to $1.50 per foot of structure; but this cost, other things being equal, would be warranted by the additional rigidity of the structure and the improved appearance.

Cars to be operated by the Interborough Rapid Transit Co. are 9 ft. wide, 52 ft. long and 36 ft. c. to c. of trucks; those to be used by the New York Municipal Railway Corporation are 10 ft. wide, 66 ft. long and 47 ft. c. to c. of trucks; all are standard-gage. Stringers are spaced 5 ft. c. to c., so that practically all stress in the ties except direct compression is eliminated. For safety it is desirable to have about 3 ft. clear between cars on adjacent tracks. For Interborough operation, however, the tracks were

*Assistant Designing Engineer, Public Service Commission for the First District, 154 Nassau St., New York.

spaced 12½ ft. c. to c. on tangents, to provide additional clearance to the through girders over the station mezzanines, while for the Municipal corporation's operation they were kept 13 ft. c. to c. With the columns placed under the stringers the transverse column spacing is

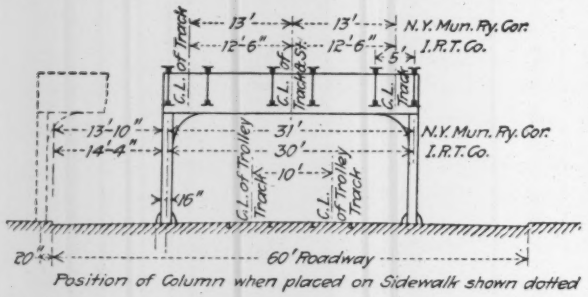

FIG. 1. TWO POSSIBLE LOCATIONS OF ELEVATED-RAILWAY COLUMNS IN STREET

(Columns at curb and column under outer stringer)

therefore 30 ft. and 31 ft. c. to c. respectively for the two companies, dividing the roadway as shown in Fig. 1.

Trolley tracks are usually spaced about 10 ft. c. to c., except where a greater width is required on account of center poles, in which cases 12½ ft. and 13 ft. are the most common spacings. When an elevated structure is built over such a line the poles are removed and the trolley wires supported from the structure. The tracks can then be spaced 10 ft. For safety to passengers a clearance of

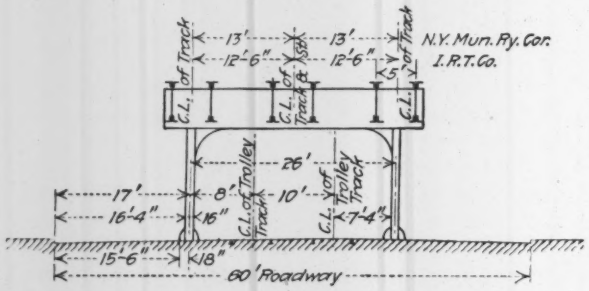

FIG. 2. LOCATION OF COLUMNS ADOPTED FOR WIDE STREETS

(On streets 44 ft. wide or less, the columns are placed inside the curb, with 47 ft. 4 in. maximum spacing)

about 3 ft. from the side of the car to the face of the column is desirable—that is, about 7½ ft. from the center line of track to face of column (although some lines are now operated in Manhattan with only 1 ft. 10 in. clear). With tracks spaced 10 ft., and 7 ft. 4 in. clear from center of track to face of a 16-in. column, the minimum spacing of columns transversely is 26 ft.

It is essential that the columns be placed far enough from the curb to allow two lines of vehicles to pass between. A minimum of from 15 to 16 ft. is required for safety. To place the columns, therefore, for greatest safety and efficiency of roadway requires a spacing of about 26 ft., as shown in Fig. 2. With columns spaced 26 ft. two lines of vehicles can pass between the curb and column and one line on each car track, six in all. With 30- or 31-ft. spacing, only one line can safely pass between the curb and column, or four in all, thus giving a 66⅔% roadway efficiency as compared to the 26-ft. spacing. The conservation of the street was deemed of greater importance than the slight structural advantage of the wider spacing. Therefore 26 ft. was adopted as the transverse spacing, except in a few isolated cases affected by special local conditions.

COLUMNS ON SIDEWALK

With roadway width 44 ft. or less, it is evident that columns cannot advantageously or safely be placed in the roadway. In order that the columns may occupy as little of the sidewalk space as possible, and at the same time be protected from traffic by the curb, they have been placed uniformly with the center 1 ft. 8 in. from the curb. With 44-ft. roadway the transverse spacing is therefore 47 ft. 4 in.

LONGITUDINAL SPACING OF COLUMNS

Except as affected by local conditions, the longitudinal spacing of columns was determined by economy. Fig. 3 shows diagrammatically the cost of those items of typical elevated construction between stations which vary with the span length, plotted for various spans both for 26 ft. and for 47 ft. 4 in. transverse spacing of columns.* An inspection of this diagram shows that 50 ft. is the economical spacing and that there is little choice of other span lengths from 40 ft. to 60 ft., above which point the cost increases rapidly with the span length. The 50-ft. longitudinal spacing of bents was therefore adopted as the standard.

At the cross-streets columns are spaced so that the interference with traffic is the minimum, 60 ft. and longer spans often being required at these points. Uniform spacing of bents between streets is often impossible on account

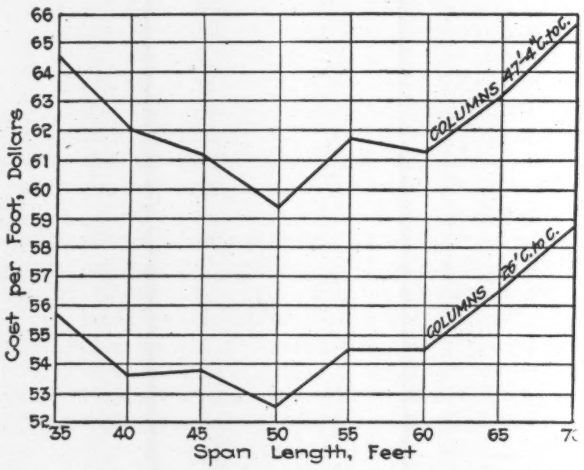

FIG. 3. EFFECT OF SPAN-LENGTH ON COST OF THREE-TRACK ELEVATED RAILWAY

(Excludes track, stations and ducts. Average prices of recent contracts used as follows: Steel, $54 per ton; cast iron, $48 per ton; concrete, $7 per cu.yd.; excavation, $2 per cu.yd.; paving, $3 per sq.yd.)

of local conditions, varying block lengths and interference with surface and subsurface structures. The 50-ft. spacing, however, has been used as far as practicable.

TYPE OF CONSTRUCTION

A deck plate-girder type of construction has been used exclusively, except over station mezzanines and in isolated cases where special conditions require other construction.

*These costs are based on present average prices, which are unusually low, particularly for steel, whose cost makes up about 80% of the cost of an elevated structure exclusive of track, signals and station finish

A half-through girder construction with longitudinal girders between the tracks has been used over the station mezzanines to reduce the depth of construction so that the climb from street to platforms will be a minimum. It is uneconomical, however, and if continuous would be a source of danger to workmen, as it gives them less chance to escape from approaching trains, particularly on the center track.

A through-truss construction is evidently impracticable with columns placed in the roadway. With columns in the sidewalk it is uneconomical and undesirable, as it obstructs light from abutting property to a greater extent.

Latticed stringers are from 10 to 15% lighter than plate-girder stringers of the same span. The cost of fabrication of the latter, however, particularly without cover-plates, is about 10% less than of a latticed girder without connection plates and 15% less than of a latticed girder with connection plates. The first cost, therefore, is practically the same in either case. Depreciation and maintenance costs of plate-girder construction are less than for latticed girders; details are simpler and the structure is more rigid. Plate-girder stringers were therefore adopted.

Expansion Joints

On the elevated extensions of the present subway, expansion joints were placed about 200 ft. apart, or about every fourth bent. In order to reduce to a minimum the tension of the top rivets of the stringer connection due to the combination of the deflection of the stringer and contraction, the distance between joints has been reduced to about 100 ft., or an expansion joint is provided at alternate bents. The cost is thus slightly increased, as the expansion detail of the stringer is slightly heavier than the detail at the fixed end, and additional bracing is required.

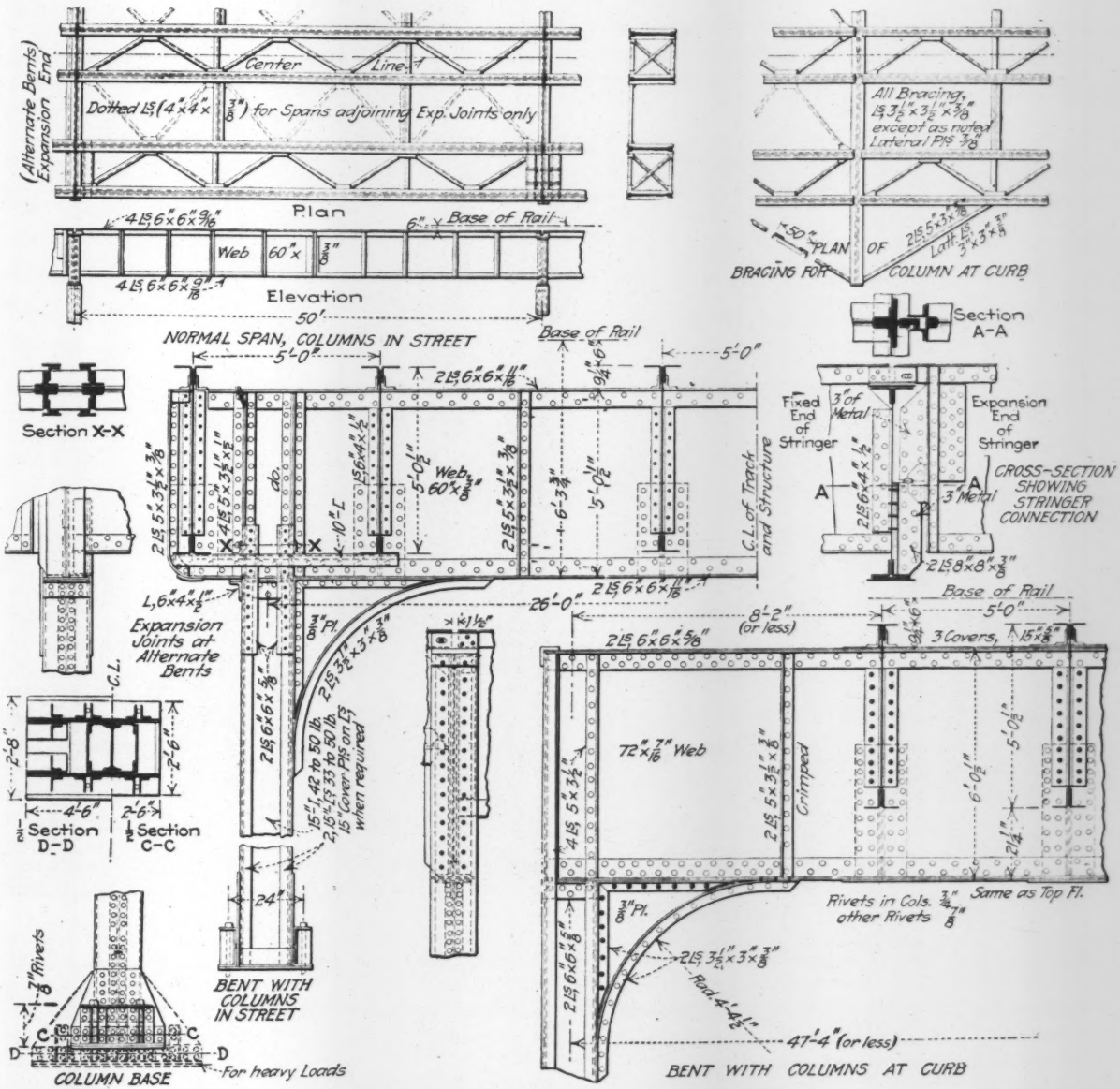

Fig. 4. Details of Elevated-Railway Construction

(New city-built lines of dual rapid-transit system, New York City)

It is expected, however, that this increase in first cost will be more than offset by a reduction in maintenance charges for replacing rivets in the stringer connections.

The expansion joint which has been used exclusively on city-built lines is shown in detail in Fig. 4. It consists essentially of a 4-in. half-round pin bearing on pin-plates on the stringer and sliding on a seat made up of angles and plates attached to the cross-girder. The thickness of plates on both seat and stringer has been made uniformly 3 in. for all spans. The pin is held in place and the stringer held in line by small guide-angles attached to the end stiffeners on the stringer. The particular advantages of this joint are its simplicity of construction and ease of erection, its accessibility for painting and inspection and the certainty of a uniform bearing on the seat. The connection of the seat to the cross-girder has been designed for the maximum shear combined with the tension on the rivets due to the maximum moment with the pin bearing on the extreme edge of the seat.

Provision has been made for a contraction or expansion of 1½ in. from normal temperature, which is undoubtedly slightly in excess of the maximum to be expected, but allows for slight inaccuracies in placing columns and in the milled length of stringers. It is desirable to reduce the opening as far as possible, in order that the pin will not approach dangerously near the edge of the seat at extreme low temperatures.

This joint has been used satisfactorily on previous elevated extensions of the subway (contract 1).

The elevated structures have been designed for the following loads:

1. Dead-load. The weight of track, including ties, rails, guard-rails, service walk, signals, etc., estimated at about 400 lb. per lin.ft. track, in addition to the weight of the structure itself.

2. Live-loads. A series of concentrations approximating the weight of the heaviest equipment it is proposed to operate on the dual system:

22,750 lb.—5 ft. 6 in.—22,750 lb.—29 ft. 11 in.—30,240 lb.—6 ft. 8 in.—30,240 lb.—8 ft. 8 in.—30,240 lb.—6 ft. 8 in.—30,240 lb.—29 ft. 11 in.—22,750 lb.—5 ft. 6 in.—22,750 lb.—9 ft. 3 in.—30,240 lb.—6 ft. 8 in.—30,240 lb.

3. Horizontal forces. (a) Wind pressure of 30 lb. per sq.ft. on the exposed surface from the top of train to the bottom of structure; (b) the sudden starting or stopping of a 500-ft. train, estimating the coefficient of sliding friction at 10%; (c) centrifugal force equal to 0.020 time the product of weight of moving cars and degree of curve, the coefficient to be reduced by 0.001 per degree for curvature between 3° and 20°.

4. Impact. With the track resting directly on the stringers the effect of the impact from the live-load will be as great as, if not greater than, on bridge spans. Live-load stresses (except for horizontal forces) have therefore been increased for impact in accordance with

$$I = 125 - \tfrac{1}{8}\sqrt{2000\,L - L^2}$$

where I = impact increment in per cent. and L = length in feet of loaded track which produces the maximum stress in the member.*

FIG. 5. NEW ELEVATED STRUCTURE WITH COLUMNS IN STREET (WHITE PLAINS ROAD, BRONX BOROUGH)

*For example, with 50-ft. spans, L for the stringer is 50 and I = 86%; for a cross-girder in which maximum stress is produced with one track loaded L = 100 and I = 70%; and for a cross-girder in which maximum stress is produced with three tracks loaded L = 300 and I = 36%. Impact is added similarly to column stresses.

On a three-track line it has been assumed that the tractive force will at no time exceed the effect of two trains acting in the same direction at the same time. On a two-track line, where the probability of trains on each track acting together is greater in proportion, provision has been made for five-sixths of the full tractive force. These assumptions, which are based on the fact that a considerable (though indeterminable) part of the tractive force is transmitted to adjacent spans through rails and expansion joints, are believed to be conservative. No data are available to determine the amount of distribution, but observation of the present lines shows that it is material. Furthermore, the probability of a train on each track at any span starting or stopping at the same time, so as to exert full tractive force on each track in the same direction, is remote. Designed on these assumptions, the new structures, a uniform distance from top of steel to base of rail. With 70-ft. span and 5-ft. depth, either cover-plates or flange angles thicker than 7/8 in. (which must be drilled from the solid) are required. Furthermore, in the long spans the 5-ft. depth is uneconomical and the deflections are excessive unless the allowable flange stress is reduced. It seemed necessary, therefore, to sacrifice appearance to economy and good practice by increasing the depth to 72 in. and 78 in. for spans 70 ft. long or over.

In cases where the length exceeded twelve times the depth of stringer, in order that the deflection (in inches) should not exceed 1/50 the span (in feet), the allowable stress was reduced to the value given by the following formula:

$$Stress = \frac{UH}{span\ in\ feet}$$

FIG. 6. NEW ELEVATED STRUCTURE WITH COLUMNS AT CURB (NEW UTRECHT AVE., BROOKLYN BOROUGH)

at a very small additional initial cost, will have greater rigidity against horizontal forces than the existing elevated extensions. This rigidity, it is believed, will increase the life of the structure and reduce the maintenance costs.

DESIGN OF STRINGERS

For spans varying in length from 45 to 60 ft. the economical depth of stringer is about 5 ft. For uniformity of appearance and details it is of course desirable to keep the depth constant as far as possible. As the number of spans exceeding 60 ft. is small, 5 ft. was adopted as the standard depth, except for spans of 70 ft. or over.

It is desirable to avoid cover-plates on stringers to reduce the cutting of ties over rivet heads. In addition the top cover-plate must be extended full length to maintain where U = the usual allowable unit-stress and H = the depth of the girder in inches.

To support the compression flanges of stringers and provide the usual truss for horizontal forces, lateral bracing between the stringers of each track was provided as shown in Fig. 4, with cross-frames at intervals varying from 12½ to 20 ft., depending on the span lengths. In addition lateral bracing was placed between stringers of adjacent tracks in one fixed span in each expansion panel in order that the tractive force from the center track should be transferred to the columns without producing lateral bending on the cross-girder.

Where the columns are outside of the outside stringer the tractive force was carried to the column by a strut from the outside stringer at the first cross-frame. The stress to be transmitted was small, requiring only two

angles. For stiffness, however, latticed struts were provided, which will be further discussed under the head of columns. Where the columns are between the stringers of the outside tracks, the tractive force was transmitted by a channel riveted to the bottom flanges of the stringers, to the stiffeners of the cross-girder over the column and thence to the column.

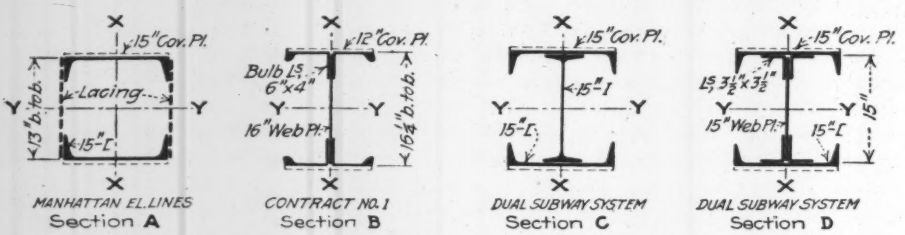

FIG. 7. COLUMN SECTIONS OF ELEVATED RAILWAYS

FIG. 8. I-BEAM DISTORTION

The top of the stringer is 9¼ in. above the top of the cross-girder, so that the top flange angles extend over to the center of the cross-girder and are supported on it by seat-angles. This detail is arranged to provide continuous support for the ties, to make unnecessary special wide spacing at the flanges of cross-girders. The rivets in these seat-angles are intended to support the ends of flange angles only and are not intended to produce continuity in the stringers—which were in all cases designed as simple spans. Splicing the stringers for continuity was considered, but was abandoned because the detail was too heavy for ultimate economy, and continuity over expansion joints was impossible. The end-connection angles were set against the webs without fillers and not carried over the lower flange angles to a bearing on the outstanding leg, as this was considered unnecessary. A saving of nearly $1 per lin.ft. of structure was thereby effected.

CROSS-GIRDERS

As previously described, all transverse bending stresses have been eliminated so far as practicable, so that the design of the cross-girder followed the usual practice of girder design. For column spacing of 47 ft. 4 in., a 6-ft. girder was used generally, while a 5-ft. girder was more economical for the 26-ft. column spacing. Stiffeners are of course provided over the column to transfer the reaction to the column. Intermediate stiffeners were provided to stiffen the girder in shipping and handling only, as the stringers when connected stiffen the web sufficiently to prevent buckling.

DESIGN OF COLUMNS

The columns have been designed for a combination of direct load and bending stresses due to wind, centrifugal and tractive forces. In combining the direct and bending stresses the following limits were adopted as giving a safe design:

1. With the direct load alone, the stress per square inch should not exceed that allowed by the Public Service Commission formula

$$S = \frac{20{,}000}{1 + \frac{l^2}{8000\, r^2}}$$

with a maximum of 14,000 lb. per sq.in.

2. With direct load combined with bending in one direction only the stress should not exceed 20,000 lb. per sq.in. on the extreme fiber.

3. With direct load combined with bending in both directions at the same time the stress should not exceed 25,000 lb. per sq.in. on the extreme fiber.

The allowable stress is increased in the latter cases due to the infrequency of maximum direct load and maxi-

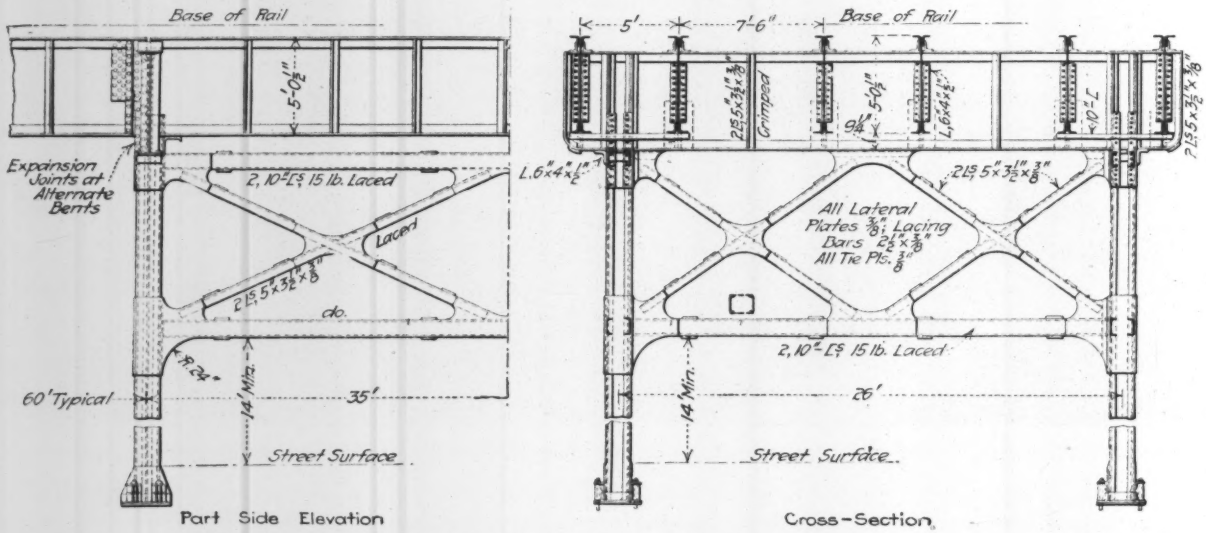

FIG. 9. TOWER CONSTRUCTION, USED FOR HEIGHTS OVER 30 FT.

mum horizontal forces in both directions simultaneously.

In computing the bending stress in the column due to horizontal forces it was assumed that the column was fixed both top and bottom (see detail of base in Fig. 4). Four 1¼-in. anchor bolts attached to the base of the column by seat-angles, with stiffeners so arranged that the nut has a direct bearing over the stiffeners, have been designed to anchor the columns.

With the columns spaced 26 ft., longitudinal bending stresses are transmitted into the column by 5x½-in. splice-bars attached to the stiffeners on the cross-girder and to the column channels. The stiffeners on the cross-girder over the columns are fixed at the bottom of the stringers by the channels previously described, while fixity at the top is secured to a large extent by the transverse stiffness of the top flange of the girder, which is held rigidly by the adjacent stringers, less than 2 ft. from the column. This bending in the flange occurs at a point where the vertical bending stresses are small and does not therefore overstress the flange. While no tests of this detail have been

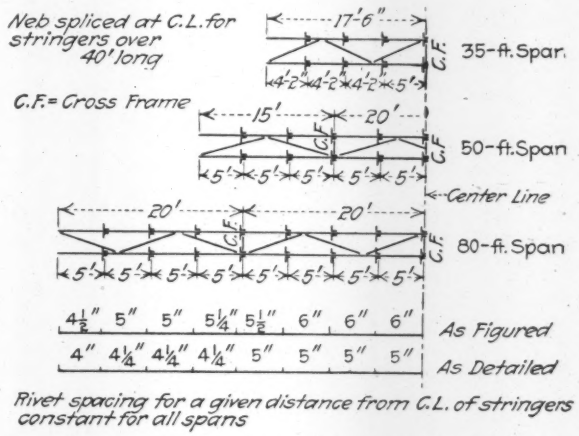

FIG. 10. LATERAL BRACING AND STRINGER RIVETING

made, it is believed that at least a fair degree of fixity in the column longitudinally is obtained.

When the columns are placed beyond the outside stringers, in place of the splice-bars just described, the outside channel of the column is extended to the top of the cross-girder and riveted to the end stiffeners, transmitting the longitudinal bending from the girder to the column. A latticed strut 50 in. deep extends from the stringer at the first cross-frame to the column (see Fig. 4; the strut is also shown clearly in the view, Fig. 6). With this depth it is believed that the column is fixed at the top.

The columns and the cross-girder being connected to form a rigid portal, the wind force produces a bending stress in the cross-girder. This, however, is small, amounting with columns spaced 47 ft. 4 in. to less than 1%, and with columns spaced 26 ft. to only 5% of the maximum stresses due to direct load. The effect of wind on the cross-girder has therefore been neglected.

In selecting the type of column no section was considered which did not permit inspection and painting, thus eliminating all box types (see Fig. 7).

Section A, with two channels laced, was used extensively on the present Manhattan Ry. Co. elevated lines. With the loads for which the columns on the new lines are designed, cover-plates would be required in practically all cases. The main material is economically placed, but this advantage is more than offset by the loss (so far as effective section is concerned) in the lacing bars, amounting to about 12% of the total weight of the column, or 15 to 18% of the weight of main material. As a result the column is not so economical as Section C, and is less satisfactory as to details.

The elevated extensions of the present subway, Contract 1, have bulb-angle columns, Section B, usually without cover-plates. On account of the difficulty of obtaining bulb angles except in large quantities, and also because the section is less efficient and economical than a channel-and-I-beam column, a bulb-angle type has not been used on the dual system.

Section C is similar to Section A, except that the channels are connected by an I-beam instead of by lacing. The beam is ineffective in resisting bending about axis X-X. The material is effectively placed, however, for resisting bending about axis Y-Y and for carrying direct load. For the elevated loading this section is particularly efficient and economical. The material in the column with a built-up instead of a rolled I-beam, Section D, is slightly less economical, and in addition there are two extra lines of rivets. The I-beam-and-channel type, Section C, was therefore adopted.

In fabricating these columns, however, some difficulty has developed. The beams as they come from the rolls are invariably slightly warped, as shown exaggerated in Fig. 8. When the channels are attached it has been difficult to avoid a wind in the column. This trouble developed after the details for a number of sections were completed. To avoid this difficulty it has been suggested that on future work the I-beam-and-channel column, Section C, be abandoned for the built-up Section D.

Fig. 9 shows the typical arrangement of tower construction which has been found to be economical where the height from street to base of rail exceeds 30 ft. A spacing of 35 ft. between bents of tower span, with standard 5-ft. stringers, proved to be more economical than a shorter span with shallower stringers, and in addition permitted greater duplication of stringers and details and maintained a uniform appearance. The long spans are varied to suit local conditions, a length of about 60 ft. being the most economical.

In order to duplicate pieces, details have been standardized wherever possible. Stiffeners and flange rivets on the stringers and the arrangement of lateral bracing and cross-frames are shown typically in Fig. 9. Cross-frames were spaced at intervals not exceeding 20 ft. Stiffeners were in general spaced about 5 ft. apart, but were placed between the panel-points of horizontal bracing except at cross-frames, thus avoiding notching lateral plates at intermediate points.

The average weight of steel, including stations, on two contracts with columns spaced 47 ft. 4 in. is about 1⅛ tons (2250 lb.) per lin.ft. structure.

The design of the subway and elevated structures of the city-built lines of the dual subway system is made by the Public Service Commission's engineering staff, of which Alfred Craven is Chief Engineer; Robert Ridgway, Engineer of Subway Construction; D. L. Turner, Deputy Engineer of Subway Construction; Sverre Dahm, Principal Assistant Engineer, in charge of design, and A. I. Raisman, Senior Designing Engineer. The design of the major portion of the elevated lines was made under the immediate supervision of the writer.

Engineering Literature

REVIEWS AND NOTES

Steel-Bridge Designing

REVIEWED BY A. W. CARPENTER*

DESIGN OF STEEL BRIDGES: Theory and Practice for the Use of Civil Engineers and Students—By F. C. Kunz, M. Am. Soc. C. E., formerly Designer for the Bridge and Construction Department of the Pencoyd Iron Works and the American Bridge Co. and Chief Engineer of the Bridge and Construction Department of the Pennsylvania Steel Co. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xxiv + 472; illustrated. $5, net.

"It is an ill wind that blows nobody good," and we may consider it a good result of bad times if the business depression has given Mr. Kunz time to prepare a book on the line of work he has practiced so long and eminently. His long experience in designing and his connection with two of our largest bridge manufacturing companies, as designer and chief engineer, give weight to whatever he writes on bridge design.

This book, which Mr. Kunz has produced as the first volume (complete in itself) of four which are contemplated to embrace a work on "Structural Engineering," treats of the design of nearly all types of steel bridges, according to modern practice—principally American, of course. The heavier forms, such as railroad and heavy highway spans, are given main attention, and long-span structures, including arches and cantilevers, are given unusual consideration for a book of such general scope. The title page states that the book is "for the use of civil engineers and students." It is well adapted for such use, provided students have the necessary elementary knowledge. Besides explaining loads, forces, stresses, general dimensioning and proportioning and some detailing, for the various types of bridges according to uptodate practice, the book abounds in illustrations of, and data for, excellent examples of modern typical and notable structures, designs and details, in labor-saving tables and methods and in references to the literature of the subject.

The subjects of the successive chapters are as follows: (1) External forces; (2) general reactions and influence lines; (3) moments and shears in simple spans; (4) stresses in simple spans; (5) stresses in bracing of simple spans; (6) types of bridges and principal dimensions; (7) design of floor; (8) beam and plate-girder bridges; (9) simple-truss bridges; (10) skew bridges and bridges on curves; (11) weights of simple-span bridges; (12) viaducts; (13) elevated railroads; (14) movable bridges and turntables; (15) arch bridges; (16) long-span bridges in general and examples; (17) cantilever bridges.

The treatment of some of the chapter subjects is quite complete, while that of others is much less so—a thoroughly exhaustive treatise in the limited space afforded could not be expected. In all cases the principles are defined and the more important types and details generally covered, all being clearly presented in a practically scientific manner, with typical examples and illustrations and accompanied by much practical information resulting from the author's experience. For an understanding of many of the mathematical demonstrations a knowledge of the simpler applications of calculus is required, and the reader is assumed to be familiar with the derivation and proof of formulas for, and applications of, the elastic theory in bending resistance, deflection, etc., or is referred to other sources for them.

A notable feature is the use of influence lines in the explanation and determination of moments, shears and stresses. Their principles are explained so that one not familiar with them should be able to follow the author readily. They are applied to simple-span polygonal-chord trusses, to swing-span trusses and to arch and cantilever trusses, for an example of each of which types the complete stresses are worked out by this method. The method seems very well adapted to types for which the positions of critical loading are difficult to determine, as it may be employed both to determine such positions and, with some extension of application, the stresses as well.

The short cuts to the determination of stresses are well described and are aided by tables of maximum moments and shears for simple spans, for Cooper's Class E-50 loading and for usual electric-car loadings, by tables of coefficients for use with influence lines, etc. In the determination of stresses in center-bearing swing-span trusses and in arches, the separate influence areas for stresses in the arms or arch spans, considered as simple spans, are combined with those for the reaction due to continuity or arch action, a method which appears to simplify calculations very materially.

Information as to live-loads and other external forces is quite complete. The live-loads of the most recent railroad specifications of the United States and Canada are shown in tabular form for ready comparison, and earlier specification loadings are similarly shown. The weights of the heaviest locomotives are given by types and for different railroads. They appear to be closely up to date, but would be more intelligible if accompanied by wheel diagrams and the comparative moment and shear effects on equal spans of usual length. Data are given for weights and dimensions of modern motor-trucks, but do not include the division of load on axles, the inequality of which is one of the most important features. Neither does the author comment on the greater severity of these loads as compared with road rollers, due to the likelihood of the trucks passing each other on bridge roadways, a condition not generally assumed to occur with road rollers.

General considerations governing the determination of bridge location, type, economical span length, proportions, etc., are quite fully and satisfactorily treated throughout. Many practical considerations, such as panel

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arrangements for skew bridges, lateral clearances for through bridges on curves, location and provision for superelevation of track on curves, are treated with unusual completeness.

Valuable assistance to designers is afforded in the tables showing the sections and makeup of typical girder flanges, truss-chord sections and viaduct-column sections, with areas and radii of gyration. These sections are properly designed and proportioned (some comment might be made on the rather extended use of 8x8-in. angles in the smaller girder-flange sections) and cover the range between the smallest and largest ordinarily employed. Other tables give the location of center of gravity of girder flanges of usual makeup.

Particular attention throughout is given to the steel weights of spans of the various types and to formulas and methods for approximating these weights. The chapter devoted to the weights of simple-span bridges gives various formulas, tables and diagrams of bridge companies and railroad companies (for railroad bridges mostly, with some for highway and electric-railway bridges) and analyzed weights for a number of typical existing spans. It seems rather unfortunate that no data for the weights of truss spans designed for Cooper's Class E-60 loading or equivalent are included. The reviewer is inclined to think the bridge companies' formulas would generally give low results for bridges designed by railroad companies. In the chapters especially devoted to those types, formulas for or actual weights of railroad viaducts, elevated railroads, swing and rolling-lift bridges, arches and cantilever spans are presented.

The number and character of data given for notable and typical existing structures are remarkable. They include tables showing dimensions of the longest plate girders, longest simple spans, typical swing bridges and notable arches and cantilevers. Briefly detailed descriptions, including dimensions, designing loads, material, weights and sometimes costs, are given for many bridges, notably swing and lift spans, arches and cantilevers; among them the new Hell Gate arch bridge at New York City. The various designs for a bridge over the North (Hudson) River at New York City are also described.

The chapters on viaducts, elevated railroads, movable bridges, arches and cantilevers are supplemented by lists of references to additional information contained in articles in technical-society proceedings, engineering periodicals and other publications.

The 52 plates, most of which are folded in the back of the book, contain a wealth of information. The attachment of the folded plates is novel and commendable, they being either pasted along their inner edges to the outer edges of blank pages, or having the inner portions blank for the width of an ordinary page, so that when unfolded the entire plate is thrown clear of the book, enabling one to refer to it and to the text of the book at some other point simultaneously. These plates show numerous sections of typical bridge flooring and floor systems, typical outlines of trusses of various types and forms, and of elevated-railway structures and viaducts; elevations of notable large bridges; reproductions of stress sheets and general detail drawings of recently designed railroad structures, including girder and truss simple spans of various forms and lengths, center-bearing swing spans with machinery details, and viaducts. General details of a large highway arch bridge are also shown. The railroads whose drawings are reproduced are the Pennsylvania (Railroad and Lines West), Missouri Pacific, Great Northern, Norfolk & Western and some others. Plates showing cross-sections of large bridges, like the East River spans at New York City, and cross-sections and makeup of compression members of long-span bridges, the largest being that of the new Quebec Bridge, comprising 1882 sq.in., are instructive.

While this book must be commended in general, there are certain limitations, deficiencies and errors which prevent it from being an entirely satisfactory and complete production. Besides those already mentioned a few may be noted:

The author sometimes fails in desired accuracy of analysis, as when he begins his book by enumerating the external forces acting on a bridge as the *dead-load, live-load, impact, wind pressure, centrifugal force, longitudinal frictional force,* etc., thus mixing up loads and their effects and not recognizing the absence of such loads and forces in certain cases. The prevalent didactic form of statement is generally correctly applied with reference to common or accepted practice; but it seems that the author should have either explained or else qualified these statements.

Some important considerations are treated very meagerly, among such being secondary stresses. Many matters of detail are hurried over with brief general description or are not covered at all in the text, as in the case of the proper size of rivets, of which there is no discussion, and net section in riveted members, which is very incompletely considered. The work on movable bridges is practically confined to center-bearing swing bridges so far as main trusses are concerned, and that on arches to spandrel-braced arch trusses. Turntables are treated merely as to bending moments, shears and reactions. All pin-connected trusses treated and shown have tension counter diagonals in the web system, the generally accepted better practice of using stiff main diagonals being practically ignored. The advantage of, and frequently principal reason for, using pin-connections, namely, as a means to the use of eye-bars for tension members where the required sections are too large for satisfactory riveted members, is not noted, nor is the combination pin-connected and riveted truss, which is an excellent type, permitting the use of eye-bars for all-tension members and riveted connections for reversible-stress members.

There is no discussion on many such debated questions as the desirability of end floor-beams in square ended simple-span bridges. The overturning effect of centrifugal force on railroad deck bridges carrying curved track seems to be underestimated. The statement that "the clear height above highways and electric railways should be not less than 16 ft. except for ordinary country roads" seems ill advised in view of the very general acceptance of 14 ft. and less. Opinions necessarily disagree as to what constitutes minimum floor depth, but the reviewer would venture to call 3 ft. (given by the author as the preferable minimum depth from top of stringer for railroad single-track truss spans) about one foot too great. In skew spans with polygonal top-chord trusses, the author indicates that it is necessary to use trusses of unsymmetrical outline; this can be avoided without detriment and a better appearance obtained, together with the economic advantage of symmetrical trusses, by using skewed top

lateral struts and sway frames and single-system top laterals.

The figures and plates are generally good, but many of the small-scale figures are not carefully drawn, as in Fig. 6, p. 210, showing end finish of span on masonry, where the backwall scales several feet away from the end of the steel floor. Fig. I, plate VI, showing the cross-section of a deck truss-span, would be impossible to follow in construction because the laterals would cut through the timber deck. An instance of bad design is shown, without comment on its deficiencies, in Fig. N, Plate V, which shows a cross I-beam floor with ties resting on timber blocks spanning between and supported on the lower flanges of adjacent beams. The design of through plate-girder railroad span shown on Plate XI is uneconomical in having an even number of very short floor panels; the floor depth is ample to permit the increase in panel length necessary to reduce the number of panels by one, giving five panels at about 14 ft. instead of six at 12 ft. In many cases the text and the figures or plates are inconsistent, as where the author states that the connection of sidewalk brackets should be such that the bending moment is transmitted to the floor-beams by rivets in shear and makes no comment on some of the illustrative designs which show connections which would transmit the moment by rivets in tension through their heads.

A good many errors in notation in the formulas and their demonstrations and a few errors of substance have been noted by the reviewer. For instance, the formula for distance between deck girders on curves, p. 217, does not agree with the figure to which it is referred. The last factor in the formulas for F and G, top of p. 220, is incorrect when $k < h$, because of faulty derivation, the varying width of clearance diagram not having been properly considered. The errors in notation consist in the use of unintended letters and symbols, omission of subscripts from symbols requiring them, and otherwise. There are also several errors in page and figure references and some in typography. The cross-referencing of subjects is attempted, but is very incomplete.

It has been noted hereinbefore that the volume under review is intended as one of a series of four, the whole of which will comprise a work on "Structural Engineering." This information is derived from the title sheet and from the author's preface. No mention is made of the other volume subjects, but it is stated that the present volume is the first of the series and complete in itself, yet all through it one finds references to "Vol. I," which apparently is intended to expound theories of mechanics applicable to steel structures, such as deflection, combined axial and bending stresses, secondary stresses, etc.

The limitations of the book do not detract from the merits of that which is presented and which covers a very large proportion of the entire field of steel-bridge design. The deficiencies and errors noted are to be regretted, but are generally not serious; few of them would mislead experienced designers using the book for reference. While it cannot be recommended as absolutely accurate or authoritative in all respects, the many unusually valuable features cannot be obscured, and the reviewer would rank this book among the very best of those which have been written on its subject and perhaps the most complete now published in a single volume of its size.

Engineering Office Systems

REVIEWED BY ALFRED D. FLINN*

ENGINEERING OFFICE SYSTEMS AND METHODS; Together with Schedules and Instructions for the Collection of Preliminary Data for Engineering Projects; Sampling, Inspecting and Testing Engineering Materials; Conducting Domestic and Export Shipping Operations; etc.—By John P. Davies, Assoc. M. Am. Soc. C. E. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xvi + 544; 243 illustrations. $5, net.

From the title one would expect a treatise on preparing, filing and indexing drawings, computations, notes, reports, letters and other papers which come into an engineering office. These subjects and kindred ones are dealt with comprehensively and compactly; but the book contains much more, 425 pages being given to collection of preliminary data for a variety of projects, to specifications for materials and work, to reminders in detail for following up and checking drawings, contracts and other documents, to inspection of materials, machines, etc., to cost keeping and estimating, to domestic and export shipping and the necessary papers, and a short chapter on miscellany, which includes schedules of engineers' fees. The lists of "reminders" and many of the forms given, while directly applicable in many cases, are intended largely as suggestions and illustrations.

Outlines are given for designs and specifications for such engineering works as steel mill buildings, steel-frame office buildings, steel bridges, foundations for buildings and machinery, tanks, mechanical transmission systems, conveyors, traveling cranes, pumps, piping, electrical switchboards, steel stacks, leather belting and passenger elevators. Detailed suggestions are given for obtaining quotations on a large variety of machines, machine and plant details, and materials of construction. Purchasing-office forms and methods are outlined. Cost keeping and estimating embrace the consulting-engineer's office, manufacturing and jobbing establishments, structural-steel estimating and general contracting. A number of examples are given of progress charts for different kinds of work and several scheduling systems. Many useful hints on minor details will be found in the book, taken from the experience of the author and other engineers. Of necessity, some subjects are treated very briefly, indeed, almost too briefly in a few cases for safe use; but others are given extended and detailed treatment.

Engineers in private practice and those in charge of large offices, public and private, will find the volume useful in many ways, and even to the man who may know as much or more on the various subjects comprised in the table of contents, it may be worth the price as a convenient compilation which can be put into the hands of assistants or kept within reach for reference. To an engineer starting or reorganizing an office, it would be especially valuable; to others it may suggest improvement in current methods.

FIELD PRACTICE: An Inspection Manual for Property Owners, Fire Departments and Inspection Offices, Covering Common Fire Hazards and Their Safeguarding and Fire Protection and Upkeep, 1914 Edition—Published by National Fire Protection Association, 87 Milk St., Boston, Mass. Flexible leather; 4x7 in.; pp. 199; $1.50.

This is a new edition of a well-known pocket book of the standard practice of the National Fire Protection Association. It gives, briefly but completely, directions for eliminating so far as possible all fire hazards in build-

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ings used for homes, factories and warehouses, etc. It should be in the hands of every considerable property owner, building superintendent and all who have responsibilities in the operation of factories and other industrial plants.

Machine-Shop Work

REVIEWED BY ROSSITER R. POTTER*

METHODS OF MACHINE SHOP WORK, for Apprentices and Students in Technical and Trade Schools. By Frederick A. Halsey, M. Am. Soc. M. E., author "Slide Valve Gears," "The Use of the Slide Rule," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 279; illustrated; $2.50 net.

One need not be closely concerned with machine-shop work to find this book of interest. Mr. Halsey states in his preface that to him the machine shop is, of all works of man, the most interesting. His book, based on lectures before the students in mechanical engineering at Columbia University, certainly reflects this attitude.

The first chapter traces the development of the manufacturing system of quantity production. This is really a condensed machine-shop history. Mr. Halsey shows that the methods of machine-shop work now in use all over the world have been almost exclusively originated by the English-speaking people. Another pleasant surprise to those who have never given the subject much thought or study is the discovery of Eli Whitney, of cotton-gin fame, as the inventor of the milling machine and the effective originator, in Mr. Halsey's opinion, of true manufacturing methods such as are in general use today.

After reading Chapter II, on precision work and workmanship, the average reader will understand in a general way how high standards of machine work are maintained and could be restored even if all existing equipment were destroyed. Chapter III, on measures of length, gives the author an opportunity to hold forth convincingly upon a favorite topic, the "metric fallacy." The subsequent chapters treat of the measurement of errors, gages, fits and limits, driving systems for machine tools, turning and boring, floor-plate work, drilling, milling, gear cutting and grinding.

Everyone interested in any way in machine-shop work will appreciate this book. Typographical errors, while not serious enough to mislead, are frequent enough to be annoying.

THE AMERICAN YEAR BOOK: A Record of Events and Progress (1914)—Edited by Francis G. Wickware, with Coöperation of a Supervisory Board Representing National Learned Societies. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. xviii + 862. $3.50.

The fifth issue of this useful annual follows the same general plan as the earlier numbers. The contents are grouped in 33 departments. The 122 contributors were directed by a supervisory board of 40 members representing 44 "learned" societies.

Departments of more direct interest to engineers are: Municipal Government, Public Resources and Public Works, Public Services, Trade, Transportation and Communication, Engineering, and Chemistry and Physics. Under Engineering, Calvin W. Rice, Secretary American Society of Mechanical Engineers, and Leon Goldmerstein contribute the various articles on mechanical engineering, and F. C. Wight, of the editorial staff of ENGINEERING NEWS, the articles on civil engineering.

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The work as a whole is a well-conceived and well-executed book of reference on just those current subjects which professional and business men most often wish to look up. Both the arrangement of the contents and the fullness of the index facilitate the use of the volume for purposes of reference.

Experiments on Weirs

REVIEWED BY ROBERT E. HORTON*

THE FLOW OVER WEIRS WITH IMPERFECT CONTRACTIONS—By George Jacob Davis, Jr., Dean of the College of Engineering, University of Alabama. Madison, Wis.: Engineering Experiment Station, University of Wisconsin. Bulletin No. 699. Paper; 6x9 in.; pp. 73; illustrated. 25c.

This bulletin contains the results of experiments carried out under the direction of Mr. Davis by various students as thesis work during the years 1906 to 1909. The apparatus used is clearly described and the defects and difficulties encountered in the work are frankly stated. The tests consisted essentially in volumetric or tank measurements of the flow over small model thin-edged weirs, with crests at various heights above the bottom of the rectangular channel, and with various crest lengths from 12 to 38 in. By varying the width of the channel of approach, different combinations of crest height, width of channel and width of weir were obtained. Examples of the detailed observations, together with the average results of each series and run of experiments, are given in the bulletin. The principal data observed were the average head in each run and the corresponding discharge in second-feet.

The only deductions from the data contained in the bulletin are the coefficients C in the formula, $Q = C l h^{\frac{3}{2}}$, where l is the crest length in feet and h is the observed head in feet, uncorrected for velocity of approach.

In order to apply the results in practice, further analysis is necessary, since the coefficient C, as computed, contains the resultant effects of contraction at the horizontal crest, end contraction and velocity of approach.

In order to determine separately the effect of variation in the horizontal contraction and end contraction, with varying height and length of crest, respectively, some assumption as to the affect of velocity of approach will be necessary. The experiments can readily be analyzed, making the same assumptions as those used by either Francis or Bazin, and it appears necessary for those desiring to apply the results in practice to make this analysis. This is unfortunate, since specific data as to the effect of imperfect contraction at the crests and ends of weirs is specially needed for practical application in conjunction with the Francis weir formula.

While by no means furnishing a sufficiently extensive basis for final determination of the problem, the experiments given in this bulletin afford a valuable contribution to the hydraulics of weirs.

MINING COSTS OF THE WORLD: A Compilation of Cost and Other Important Data on the World's Principal Mines. By Edmond Norton Skinner and H. Robinson Plate. New York and London: McGraw-Hill Book Co., Inc. Flexible leather; 5x8 in.; pp. viii + 406; maps; $5 net.

Mining engineers who have the cost-data collecting habit will find in this book a laborious compilation of costs and other operating data on about 325 metal mines in various parts of the world, chiefly condensed from com-

*Consulting Hydraulic Engineer, 57 North Pine Ave., Albany, N. Y.

pany reports. It is essentially a handbook of mining activities and as such should be of value for reference to the investor as well as those interested in the actual operation and development of mines. The authors announce their intention of adding new material to the book from time to time.

Applied Mechanics

REVIEWED BY ALTON L. SMITH*

HANCOCK'S APPLIED MECHANICS FOR ENGINEERS—Revised and rewritten by N. C. Riggs, Professor of Theoretical and Applied Mechanics in the School of Applied Science of the Carnegie Institute of Technology. New York: The Macmillan Co. Cloth; 5x8 in.; pp. viii + 441; 289 illustrations. $2.40.

The topics covered by this book are practically the same as in other texts on the subject. There are really three parts. The first part (182 pp.) takes up the elementary theorems relating to forces, couples and graphical statics, with considerable matter on "center of gravity" and "moment of inertia." The second portion (62 pp.) discusses the laws of motion, rectilinear and curvilinear, as applied particularly to independent bodies. The third section deals with the dynamics of a rigid body, energy, work, friction and impact.

Some idea of the new rewritten edition as compared with the old may be gained from the following facts: With an unchanged page and type size, increase in pages is nearly 15%; increase in problems, nearly 70%; increase in illustrations, over 40%, while a reduction to three-fourths the bulk of the original shows a proper regard for the modern demand for smaller books with more in them. As to changes in form of subject matter, the method of treatment is different in some sections, particularly in the way of more extensive use of graphical methods of solution. One of the chief features of the first edition was the attempt to secure a closer relation between the theory and the practical application of mechanical principles, and this has been emphasized in the new text. The problems selected cover a wide range of engineering topics, and to get answers something more than mere substitution of values in appropriate equations is necessary. Where the text has been rewritten, a careful comparison with the old reveals in many instances a more rigorous and complete mathematical exposition, with some decrease in lucidity for the average reader. This, in connection with the fact that familiarity with mathematics through calculus is presupposed, while not unsatisfactory for the student working under an instructor, in the opinion of the reviewer, will impair its usefulness as a reference for the practicing engineer, who seldom wishes to spend much time digging out such things.

The subject of moments of inertia has been presented more completely than in other similar books, and while this matter is exceedingly useful, it is an open question if such topics could not be better handled in a course on engineering mathematics, thus enabling the student of mechanics to concentrate more intensively on the subject in hand. This, however, is not a defect of the textbook, but of the engineering curriculum.

To the generation of engineers who were brought up on Rankine, the textbook furnished to modern students would appear like a story in words of one syllable. Whether or not a student who uses the text before us acquires more brain power than the one who overcame the difficulties of Rankine, he certainly should secure possession of a far better working knowledge of the subject.

The book in its improved form should be even more satisfactory than the earlier edition.

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Vitruvius in New and Handsome Form

VITRUVIUS; THE TEN BOOKS ON ARCHITECTURE. Translated by Morris Hicky Morgan, late Professor of Classical Philology in Harvard University. With illustrations and Original Designs Prepared under the Direction of Herbert Langford Warren, Nelson Robinson Jr. Professor of Architecture in Harvard University. Cambridge, Mass.: Harvard University Press. Cloth; 7x10 in.; pp. xiii + 331; illustrated; $3.50 net.

The engineer as well as the architect may well feel grateful to all who had a hand in translating, illustrating and publishing this worthy and handy edition of Vitruvius.

It is interesting to note how much of engineering and closely allied matters the volume contains. Half of Book I is devoted to what we now call city planning. Two-thirds of Book II is on building materials and their properties and how to build walls. Although the next five books are chiefly but not wholly architectural, they contain sections on harbors, breakwaters, shipyards, and on foundations. Book VII deals in part with floors, lime, and marble for stucco, vaulting and stucco work, and with natural and artificial colors and pigments. The eighth book is on water and water-supply; the ninth on astronomy, astrology, weather prognostics, sun dials, and water clocks; and the tenth on various machines, including those for raising water and military engines.

It will be understood that the chief value of Vitruvius today is historic. Naturally, the most useful portions, except as curious examples of early pseudo-science, are those dealing with the orders of architecture and the architectural principles and practice followed in the design of Grecian and Roman buildings. Here, too, we find the most useful of the illustrations which adorn the present edition.

Scores of interesting passages might be cited to illustrate the crude or naïve scientific theories of Vitruvius' day or to prove that human nature and professional problems were essentially the same then as now. A few instances must suffice. Discoursing upon the importance of planning the direction of streets so as to break rather than increase the force of the winds (p. 27) Vitruvius says:

> Those who know names for very many winds will perhaps be surprised at our setting forth that there are only eight. Remembering, however, that Eratosthenes of Cyrene discovered from the course of the sun the shadows cast by an equinoctial gnomon, and the inclination of the heaven that the circumference of the earth is 252,000 stadia, that is, 31,500,000 paces, and observing that an eighth part of this, occupied by a wind, is 3,937,500 paces, they should not be surprised to find that a single wind, ranging over so wide a field, is subject to shifts this way and that, leading to a variety of breezes.

The relatively long book on water-supplies (pp. 225-48) opens with this simple direction for finding underground water:

> Before sunrise lie down flat in the place where the search is to be made, and placing the chin on the earth and supporting it there, take a look out over the country. In this way the sight will not range higher than it ought, the chin being immovable, but will range over a definitely limited height on the same level through the country. Then dig in places where vapors are seen curling and rising up into the air. This sign cannot show itself in a dry spot.

Although all waters are wet, their quality varies and some are dangerous. Above a spring "in the Island of Zea" this epigram was cut:

> This stone sweet streams of cooling drink doth drip,
> But stone his wits become who doth it sip.

Not quite so bad, but unpleasant to contemplate, was a spring "at Susa, the capital of the Persian Kingdom," which gave rise to the following warning:

> Stranger, you see the water of a spring
> In which 't is safe to men their hands to lave;
> But if the weedy basin entering
> You drink of its unpalatable wave,
> Your grinders tumble out that self-same day
> From jaws that orphaned sockets will display.

As a final example of the pleasant surprises which occur at frequent intervals in this interesting old treatise, we quote a complaint against underestimates of cost and a plea for the employment of architects of proper scientific training:

> In the famous and important Greek City of Ephesus there is said to be an ancient ancestral law, the terms of which are severe, but its justice is not inequitable. When an architect accepts the charge of a public work, he has to promise what the cost of it will be. His estimate is handed to the magistrate, and his property is pledged as security until the work is done. When it is finished, if the outlay agrees with his statement, he is complimented by decrees and marks of honor. If no more than a fourth has to be added to his estimate, it is furnished by the treasury and no penalty is inflicted. But when more than one-fourth has to be spent in addition on the work, the money required to finish it is taken from his property.
>
> Would to God that this were also a law of the Roman people, not merely for public, but also for private buildings. For the ignorant would no longer run riot with impunity, but men who are well qualified by an exact scientific training would unquestionably adopt the profession of architecture. Gentlemen would not be misled into limitless and prodigal expenditure, even to ejectments from their estates, and the architects themselves could be forced, by fear of the penalty, to be more careful in calculating and stating the limit of expense, so that gentlemen would procure their buildings for that which they had expected, or by adding only a little more. It is true that men who can afford to devote four hundred thousand to a work may hold on, if they have to add another hundred thousand, from the pleasure which the hope of finishing it gives them; but if they are loaded with a fifty per cent. increase, or with an even greater expense, they lose hope, sacrifice what they have already spent, and are compelled to leave off, broken in fortune and spirit.

We trust that the foregoing comments and quotations will make new friends and revive old friendships for Vitruvius, an architect and engineer of the olden time.

EXAMINATION OF WATER for Sanitary and Technical Purposes—By Henry Leffmann, Professor of Chemistry in the Woman's Medical College of Pennsylvania and in the Wagner Free Institute of Science. Seventh edition, revised and enlarged. Philadelphia: P. Blakiston's Son & Co. Cloth; 5x8 in.; pp. xvi + 140; illustrated. $1.25.

The many editions which this book has passed through since it originally appeared under joint authorship with Dr. William Bean is testimony to its usefulness as one of the most concise and handy of the available books on water analysis. The author states that the "present edition has been extensively revised, and the procedures brought into general agreement with those received by the American Public Health Association."

Vol. X of the Illinois Engineering Experiment Station Bulletins (Champaign, Ill.) contains a number of papers that many engineers will need to keep on file as furnishing necessary data in their future work. Tests of I-beams in bending, a study of Illinois sands for mortar, and bond tests of reinforced concrete are of chief structural interest. Properties of electrolytic iron and acoustics of auditoriums furnish less commonly needed data. Dynamometer tests of an electric car and studies of Illinois coal washing are also reported. The volume is, of course, a mere grouping of the separate bulletins as they appeared earlier.

A Broad Course in Electrical Engineering

PRINCIPLES AND PRACTICE OF ELECTRICAL ENGINEERING. By Alexander Gray, Assistant Professor of Electrical Engineering, McGill University, Montreal, Can.; author of "Electrical Machine Design." New York and London: McGraw-Hill Book Co., Inc. Cloth; 7x10 in.; pp. xxi + 391; 449 illustrations; $3 net.

The author has taken one of his courses for civil-, mechanical- and mining-engineering students as the basis for a text which is aimed to help certain students not specializing in electricity to a working knowledge of fundamental electrical concepts. An interesting feature gives peculiar economy in students' time and interest: the parts which require more involved explanations and are of lesser practical importance are put in small type so that they can be passed over if the student is willing to accept them as statements of experimental facts. Certain problems and illustrative data are put in small type also, but there is little chance of these being passed over. Although essentially a non-mathematical treatise, the author does not hesitate to use mathematical forms of statement and even the symbols of differential calculus.

It could not be expected that the various topics taken up here would be handled with much novelty; and of course, novelty is secondary to clear and accurate presentation. The author's scheme, or style, could be improved in these respects, although some readers probably would like to find an amplification of the sections on electric lighting and traction. Certainly, any teacher who introduces this book in his broader courses will not, if he is blessed with students who want to understand the subject, suffer from some of the disappointments which instructors too commonly meet. Any engineer who regrets his own inattention to electrical practice while in college or the inability of his instructors to elucidate apparently difficult problems can read this book with satisfaction and profit.

The author briefly passes over magnetism, electromagnetism, induction, work and power, and the laws of electric and magnetic circuits, to take up such practical apparatus as rheostats, solenoids, lifting magnets and direct-current motors and generators. To the last two he gives particular attention, disclosing principles of design and operation and many details of mechanical construction. This treatment is pushed into commutation, armature reactions, type characteristics, efficiencies and losses, and motor applications—including starters and controllers. What he offers here is always of immediate practical bearing, and it is surprising to see how much has been included.

A short excursion is made into "electrolysis and batteries." The modern ramifications of electrolytic theory are not given place; there is merely enough to show the chemical and electrical results secured in primary and secondary cells, various types of which are described and pictured. While it might seem a bit afield, yet, considering the class of readers to be reached and the title of the book, it would have been useful to have penetrated the mysteries of electrolytic action further—particularly in

regard to the corrosion of iron and the destruction of buried structures by stray currents. Generator-and-battery outfits are described briefly for stationary and railway-car service.

Following this there is an abrupt shift to alternating-current phenomena and representation. Alternating-current generators and motors are inherently more difficult to present, but some of the difficulties are eliminated by the use of tri-color diagrams.

Toward the close of the book there is an all too brief review of heavy electric traction, hoisting, long-distance energy transmission, and the essentials of good illumination. The volume ends, except for the index, with a 20-experiment laboratory course to accompany the lecture and reading work outlined above; the tests are studies of direct- and alternating-current circuits, performance of motors, generators and transformers, losses in machinery, etc.

Agricultural Mathematics

REVIEWED BY R. P. TEELE*

MATHEMATICS FOR AGRICULTURAL STUDENTS—By Henry C. Wolff, Assistant Professor of Mathematics, University of Wisconsin. [Modern Mathematical Texts.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 5x8 in.; pp. ix + 309; 127 illustrations. $1.50, net.

This volume is designed as a textbook for a half-year or one-year course, nominally for agricultural students. As pointed out by the author, it is equally useful for other students, except that the examples and illustrations all relate to agricultural subjects. As a rule, mathematical textbooks deal with a single branch and are designed to meet the needs of students who wish to specialize in mathematics, but this text is prepared for the student who wishes to acquire only such knowledge of the various branches as he is likely to need in other lines of science, and therefore covers a wide range, beginning with a review of algebra and geometry.

It is not likely that the book will appeal to the mathematician, as he will consider it superficial, but there is a real need for such courses as this in all sciences, and Professor Wolff's work seems to fill this need in mathematics.

The chapters on graphic representation and the plotting of experimental data will be found especially useful to those who are engaged in research work of any kind. The appendix contains symbols, formulas and useful tables.

This book should prove useful to persons who find a need for more mathematics than they had in school, as well as to the class of students for whom it was prepared.

Reprints of papers on "Some Types of City Government" and "One Year of City Government in Dayton, Ohio," by Lent D. Upson, Director of the Bureau of Municipal Research, Dayton, Ohio, have been published by the Bureau.

An article on "Fly-Wheel Explosions," reprinted from *Insurance Engineering*, and a lecture on "Steam-Boiler Explosions," delivered by William H. Boehm before the Student Branch of the American Society of Mechanical Engineers at Cornell University, can be obtained from the Fidelity and Casualty Co., 92 Liberty St., New York City.

*Office of Experiment Stations, U. S. Department of Agriculture, Washington, D. C.

Belated reports of the Pennsylvania Department of Health for 1910 and 1911, each in two volumes, have appeared. A considerable portion of the volumes is occupied by the reports of F. Herbert Snow, until recently Chief Engineer of the Department. The action by the department at the time of the failure of the Austin dam is detailed in the 1911 report.

The U. S. Coast and Geodetic Survey has recently issued a new addition to its "Plane Table Manual," by Assistant D. B. Wainwright. As is well known, this is the standard text on planetable surveying and is the source from which most of the material in textbooks on this branch of surveying is drawn. It is largely a reprint with some slight corrections of previous editions. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 50c.

City-Planning Literature

Under the title "Development and Present Status of City Planning in New York City" the Committee on the City Plan has issued its report for 1914. A number of papers are contributed by members of the committee and others. Some interesting maps, diagrams and photographs are included.

A quarterly entitled *The City Plan* has been started as the official organ of the National Conference on City Planning (19 Congress St., Boston, Mass.). The price is 25c. a copy, or $1 a year. The first number contains a brief paper on "The Landscape Architect as the Ally of the Sanitarian," by former President Charles W. Eliot of Harvard University, together with a number of other brief papers and some official announcements.

The City Plan Commission of Bridgeport, Conn., has issued a preliminary report, which consists of a brief statement followed by a report on city plan by John Nolen, Cambridge, Mass. Mr. Nolen's report includes, among other things, two pages on a street-traffic investigation made under his direction (see ENGINEERING NEWS, Jan. 21, 1915, p. 111).

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale, and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AMERICAN ASSOCIATION OF PORT AUTHORITIES—Proceedings and Papers of Third Meeting, Baltimore, Md., Sept. 8-10, 1914; with Constitution and Summary of Ports. New York: Wm. J. Barney, Secy., 29 Broadway. Paper; 6x9 in.; pp. 286.

AMERICAN HANDBOOK FOR ELECTRICAL ENGINEERS: A Reference Book for Practicing Engineers and Students of Engineering—Compiled by a Staff of Specialists, Harold Pender, Editor-in-Chief; Professor of Electrical Engineering, University of Pennsylvania; formerly Director of Electrical Engineering Research Laboratory, Massachusetts Institute of Technology, New York: John Wiley & Sons, Inc. London: Chapman & Hall. Flexible leather; 4x7 in.; pp. xviii + 2023; illustrated. $5, net.

AMERICAN SCHOOL BUILDING STANDARDS—By Wilbur T. Mills, Architect. Columbus, Ohio: Franklin Educational Publishing Co. Second edition. Flexible leather; 5x8 in.; pp. 616; illustrated. $5.

ANNUAL REPORTS OF THE PRESIDENTS OF THE BOROUGH OF BROOKLYN, New York City, For 1912 and 1913—

Brooklyn, N. Y.: Office of the President of the Borough of Brooklyn. In Two Volumes. Cloth; 7x10 in.; pp. 325 and 313.

THE BUDGET OF THE CITY OF DAYTON, 1915, As Enacted by the City Commission, Feb. 6, 1915. Dayton, Ohio: Bureau of Municipal Research, 2nd Floor, U. B. Bldg. Paper; 6x9 in.; pp. 52.

BULLETINS OF U. S. DEPARTMENT OF AGRICULTURE—Washington, D. C. Paper; 6x9 in.; illustrated.

No. 181: A Report on the Methods and Cost of Reclaiming the Overflowed Lands Along the Big Black River, Mississippi—By Lewis A. Jones, Drainage Engineer, Assisted by W. J. Schlick, Drainage Engineer, and C. E. Ramser, Assistant Drainage Engineer. Pp. 39.

No. 190: The Drainage of Irrigated Land—By R. A. Hart, Supervising Drainage Engineer. Pp. 34.

No. 198: Report Upon the Cypress Creek Drainage District, Desha and Chicot Counties, Arkansas—By S. H. McCrory, O. G. Baxter, D. L. Yarnell, L. A. Jones and W. J. Schlick, Drainage Engineers. Pp. 20.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS AND STREET AND ELECTRIC RAILWAYS, With Summary of the Electrical Industries, 1912—Washington, D. C.: Bureau of the Census. Cloth; 9x12 in.; pp. 440.

THE CITY MANAGER: A New Profession—By Harry Aubrey Toulmin, Jr., author of "Social Historians." New York and London: D. Appleton & Co. [National Municipal League Series.] Cloth; 5x8 in.; pp. xi + 310. $1.50, net.

CITY MANAGERS' ASSOCIATION—Proceedings of First Annual Convention, Springfield, Ohio, Dec. 2-4, 1914. Cadillac, Mich.: Secy., O. E. Carr. Paper; 6x9 in.; pp. 46.

CLASSIFIED SELECTED LIST OF REFERENCES ON CITY PLANNING—By Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University. Boston: (19 Congress St.): National Conference on City Planning. Paper; 7x10 in.; pp. 48. 50c.

THE COST OF TILE DRAINAGE: A Study of the Cost of Installing Thirty-Five Miles of Tile Drains on a Farm in Huron County, Ohio—By L. H. Goddard and H. O. Tiffany. Circular No. 47. Wooster, Ohio: Ohio Agricultural Experiment Station. Paper; 6x9 in.; pp. 44; illustrated.

COUNTY AND MUNICIPAL INDEBTEDNESS 1913, 1902 AND 1890, AND SINKING FUND ASSETS 1913—Washington, D. C.: Bureau of the Census. Paper; 9x12 in.; pp. 228.

CRACKERJACKS ON IRRIGATION and Advice to Rio Grande Valley Farmers—By H. Scougall, C. E. El Paso, Tex.: International Book & Stationery Co. Paper; 6x9 in.; pp. 16. 25c.

DIRECT-ACTING STEAM PUMPS—By Frank F. Nickel, Associate in Mechanical Engineering, Columbia University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x + 258; 218 illustrations. $3, net.

ENGINEERING ECONOMICS: First Principles—By John Charles Lounsbury Fish, M. Am. Soc. C. E., Sometime Division Engineer Lake Shore & Michigan Southern Ry.; Professor of Railroad Engineering at Leland Stanford Junior University; author of "Earthwork Haul and Overhaul," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xii + 217; illustrated. $2, net.

FIELD BOOK OF AMERICAN TREES AND SHRUBS: A Concise Description of the Character and Color of Species Common throughout the United States, together with Maps Showing Their General Distribution—By F. Schuyler Mathews, author of "Field Book of American Wild Flowers," "Field Book of Wild Birds and Their Music," "Familiar Life of Field and Forest," "Familiar Features of the Roadside." New York and London: G. P. Putnam's Sons. Cloth; 4x7 in.; pp. xvii + 465; profusely illustrated. $2, net.

A HANDBOOK OF COLUMN REINFORCEMENT for Architects, Engineers and Builders of Reinforced Concrete Building Construction: Containing Tables of Column Spirals, Column Vertical Steel, Safe Column Loads, Flat Slab Floor Thicknesses and Other Useful Information. Chicago: (McCormick Bldg.) Concrete Steel Products Co. Linen; 5x8 in.; pp. 39; illustrated. 50c.

INDUSTRIAL DIRECTORY OF NEW YORK STATE (1913)—Albany, N. Y.: State Department of Labor. Cloth; 6x9 in.; pp. 787.

A list of factories in the state classified by products and by counties, and giving the number of employees in each. Summary tables are included. A "Directory" for 1913, published in 1915, is a bit out of date.

AN INTRODUCTION TO TOWN PLANNING: A Handbook Dealing with the Principles of the Subject and a Consideration of the Problems Involved, Powers of Local Authorities, etc.—By Julian Julian, Borough Surveyor, Cambridge. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Co. Cloth; 5x8 in.; pp. vi + 149; illustrated. $1.75, net.

LEAGUE OF MINNESOTA MUNICIPALITIES—Proceedings of the Second Annual Convention, Mankato, Minn., Oct. 21-22, 1914—Minneapolis: Prof. Richard R. Price, Secretary. Paper; 6x9 in.; pp. 160.

LOCAL IMPROVEMENTS BY SPECIAL ASSESSMENT IN ILLINOIS: Outlines of Procedure and Forms for the Construction of Local Improvements in City, Town or Village in Illinois. References are made to Sections of the Local Improvement Act, and to a few Supreme Court Decisions. Chicago: Universal Portland Cement Co. Paper; 6x9 in.; pp. 48.

MATERIALS OF CONSTRUCTION: Their Manufacture, Properties and Uses—By Adelbert P. Mills, Assoc. M. Am. Soc. C. E., Assistant Professor of Materials, College of Civil Engineering, Cornell University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xxi + 682; 346 illustrations. $4.50, net.

MORTALITY STATISTICS, 1913—Washington, D. C.: Bureau of the Census. Cloth; 9x12 in.; pp. 631.

NEW SOUTH WALES DEPARTMENT OF PUBLIC WORKS—Report for Year Ended June 30, 1914. Sydney, N. S. W.: The Department. Paper, 8x13 in.; pp. 14; illustrated.

OFFICIAL RAILROAD MAP OF CALIFORNIA—Published by the California Railroad Commission, 533 Market St., San Francisco. Scale, 15 mi to 1 in., with detailed maps of Los Angeles, San Francisco and San Diego districts.

Engineers visiting California this year will be interested to obtain a copy of this excellent map.

OPINIONS AND DECISIONS OF THE RAILROAD COMMISSION OF WISCONSIN—Vol. XIII, Nov. 4, 1913, to Feb. 16, 1914. Madison, Wis.: Secy., Lewis E. Gettle. Cloth; 6x9 in.; pp. 939.

OVERCROWDING AND DEFECTIVE HOUSING IN THE RURAL DISTRICTS—By Dr. Harvey D. Bashore, Inspector for Pennsylvania Department of Health; author of "The Sanitation of a Country House," "The Sanitation of Recreation Camps and Parks," "Outlines of Practical Sanitation." New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xi + 92; illustrated. $1, net.

A PLANE TABLE MANUAL—By D. B. Wainwright, Assistant. Appendix No. 7—Report for 1905. (Reprint with corrections, January, 1915.) Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 6x12 in.; pp. 291—341; illustrated.

POWER, HEATING AND VENTILATION: A Treatise for Designing and Constructing Engineers, Architects and Students. (In Three Parts, Each Complete in Itself)—By Charles L. Hubbard, Consulting Engineer. Part III, Combined Power and Heating Plants. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; x + 408; 220 illustrations. $3, net.

PUBLIC UTILITIES: THEIR FAIR PRESENT VALUE AND RETURN—By Hammond V. Hayes, Consulting Engineer; author of "Public Utilities: Their Cost New and Depreciation." New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. viii + 207. $2, net.

RAILROAD FIELD MANUAL FOR CIVIL ENGINEERS—By William G. Raymond, M. Am. Soc. C. E., Professor of Civil Engineering and Dean of the College of Applied Science in the State University of Iowa. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Leather, 5x7 in.; pp. vii + 398; 31 text figures and 83 tables. $3, net.

REGULATIONS FOR FIXTURES TO BE CONSTRUCTED AT WASHINGTON MARKET, Borough of Manhattan, City of New York—Report and Draft by Charles Houchin Higgins. New York: Office of President, Borough of Manhattan, Municipal Bldg. Paper; 7x10 in.; pp. 56.

REPORT OF THE RECLAMATION BOARD OF CALIFORNIA, 1914—Sacramento, Calif. Paper; 6x9 in.; pp. 22.

REPORT UPON THE COLLECTION AND DISPOSAL OF THE SEWAGE OF THOSE SECTIONS OF MARYLAND ADJACENT TO THE DISTRICT OF COLUMBIA, To the Sewerage Commission of Montgomery and Prince George's Counties—By Robert B. Morse, Chief Engineer, Maryland State Department of Health. Paper; 7x10 in.; pp. 60; illustrated.

SNAPPING CORDS: Comments on the Changing Attitude of American Cities Toward the Utility Problem—By Morris Llewellyn Cooke, Director of Public Works, Philadelphia, Penn. Paper; 6x9 in.; pp. 42. Additional copies may be had free of charge on application to the Department of Public Works, Room 216, City Hall, Philadelphia.

Two lectures given at various Eastern universities during the early part of 1915.

TELEPHONES AND TELEGRAPHS and Municipal Electric Fire-Alarm and Police-Patrol Signaling Systems, 1912—Washington, D. C.: Bureau of the Census. Cloth; 9x12; pp. 208.

TRATTATO DI COSTRUZIONI ANTISISMICHE, Preceduto da un Corso di Sismologia—By F. Masciari-Genoese. Milan, Italy: Ulrico Hoepli, Editore Libraio Della Real Casa. Paper; 7x10 in.; pp. xxviii + 1004; 900 text figures. 24 Lire.

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No. 338: Springs of California—By Gerald A. Waring. Pp. 410.

Nos. 340-F and 340-G: Stream-Gaging Stations and Publications Relating to Water Resources 1885-1913—Part VI, Missouri River Basin; Part VII, Lower Mississippi River Basin. By B. D. Wood.

No. 345-I: Gazetteer of Surface Waters of Iowa—By W. G. Hoyt and H. J. Ryan. Pp. 225.

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No. 375-A: Ground Water for Irrigation in the Sacramento Valley, California—By Kirk Bryan. Pp. 49.

Field and Office

Derrick Car for Elevated-Railway Reconstruction

By J. M. Ryan*

In third-tracking the elevated railways of New York City considerable of the steelwork is being handled on the structure by a special derrick car of 8 tons' capacity, which was built by the Snare & Triest Co. especially for this work. The requirements for this car were that it could be set up quickly, moved rapidly, handle the loads safely and not overload the structure.

The body is an elevated-railway steel flat-car, 8x51 ft., reinforced with three 10x10-in. yellow-pine sills the full length of the deck. Subway trucks, which are of heavier construction, were used. On the front of the body is seated a 19-ft. A-frame, of 8 ft. spread, to serve as derrick mast. The boom is 38 ft. long; it can handle the full 8-ton load at reaches up to 36 ft.

The A-frame is pin-connected at the bottom and supported by a built-up steel girder equipped with short posts for blocking at each end; this girder also supports the boom-seat. Through the blocking the reactions of A-frame and boom are transferred directly to the structure without any of the load coming on the car truck. At the head of the A-frame there is a heavy steel plate to which the topping-lift and backstay are attached. The two back-stays are each three parts of 1-in. plow-steel cable attached at the bottom to steel plates bolted to the car-sill channels directly over the rear truck. The uplift at the rear of the car is taken care of by steel clamps which connect to the track rails and are operated by quick-acting screws.

When the car is not in use the A-frame is tilted backward to reduce the headroom to 12 ft. The topping-lift is provided with a five-part line of ¾-in. plow-steel cable. The load line is a four-part tackle of a ¾-in. cable. Swinging lines are attached to each side of the boom, composed of 1½-in. manila rope rove through two triple blocks and operated by a 7½-hp. auxiliary electric hoist (J. S. Mundy Co.) which produces a 1000-lb. pull on each spool at 100 lin.ft. per min. For side lifts up to

*Assistant Engineer, Manhattan Elevated Improvements; the Snare & Triest Co., New York, N. Y.

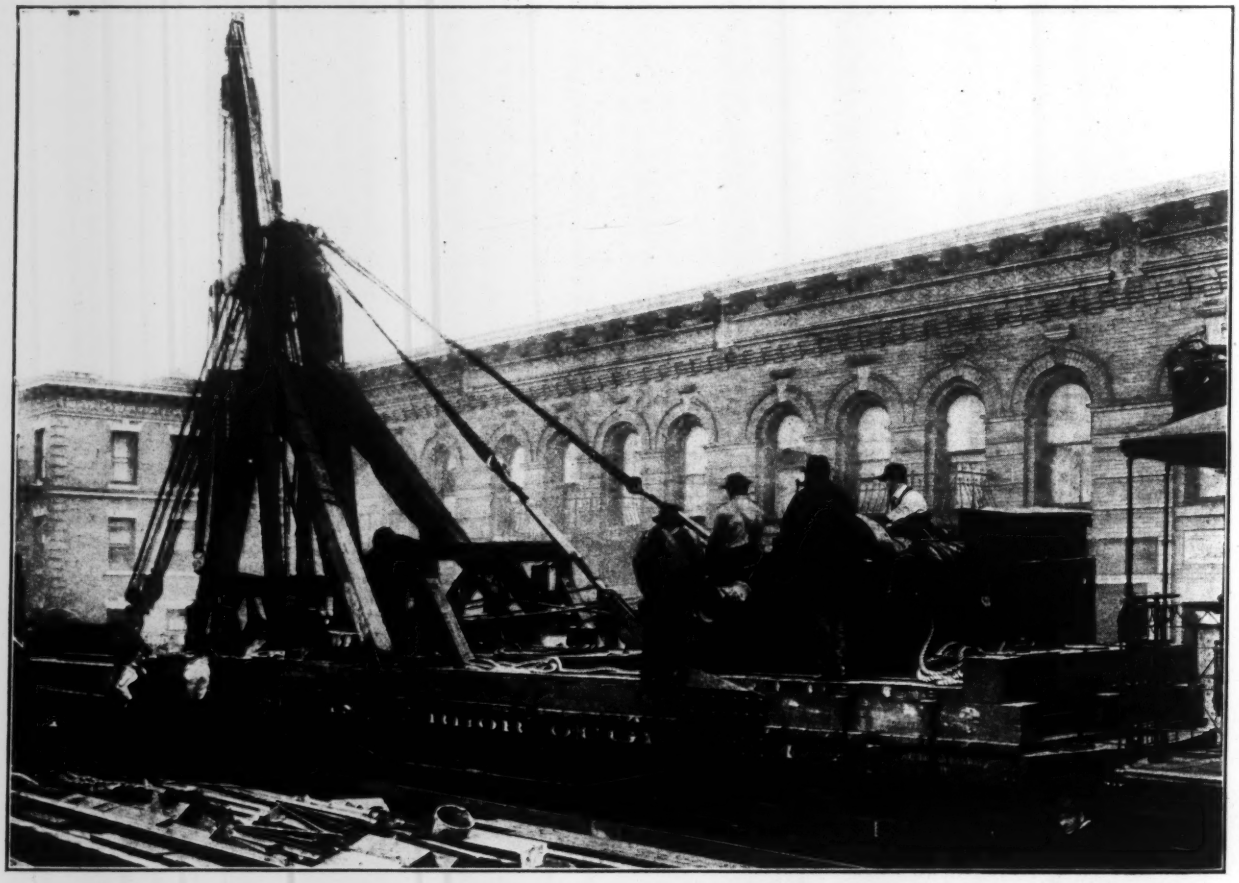


Fig. 1. Derrick Car in Action

(On Third Ave. at 174th St. Station, New York City. Setting platform steel)

4 tons the A-frame is guyed from the top plate with a seven-part line of 1½-in. manila rope. The guys connect at the bottom with a steel sling passed around a girder of the elevated structure. The guys are operated from the main hoist. For loads exceeding 4 tons guys composed of three parts of 1-in. plow-steel cable are used. These are provided with steel turnbuckles for adjustment.

The hoisting is done with a 43-hp. motor operating at 550 to 650 volts direct current, the current taken directly from the contact rail on the structure through a shoe on the derrick car. The hoisting engine is of the two-drum two-spool type, built by the Lambert Hoisting Engine Co.; the speed of the motor is 580 r.p.m. and the pull in a single line at 150 ft. per min. is 7000 lb.

The steel members to be erected are pushed ahead of the derrick car on a steel flat-car or idler, which also carries the head of the boom when the latter is not in action. At convenient points the material is hoisted from the street to the idler by the derrick car and set on blocking. The derrick car and idler are moved where desired by a construction motor car. Arrived at a point of erection, the car is blocked and properly guyed. Three minutes are required to set a girder. The regular running tracks of the railway are used, the steelwork being set between regular trains without interfering with traffic. As an indication of the erection speed possible with this derrick car, on one job 34 stringers, each about 40 ft. long and totaling 85 tons in weight, were transported about 2 mi. and set in 4½ hr. during normal traffic conditions. W. P. Rothrock is in charge of this work for the Snare & Triest Co.

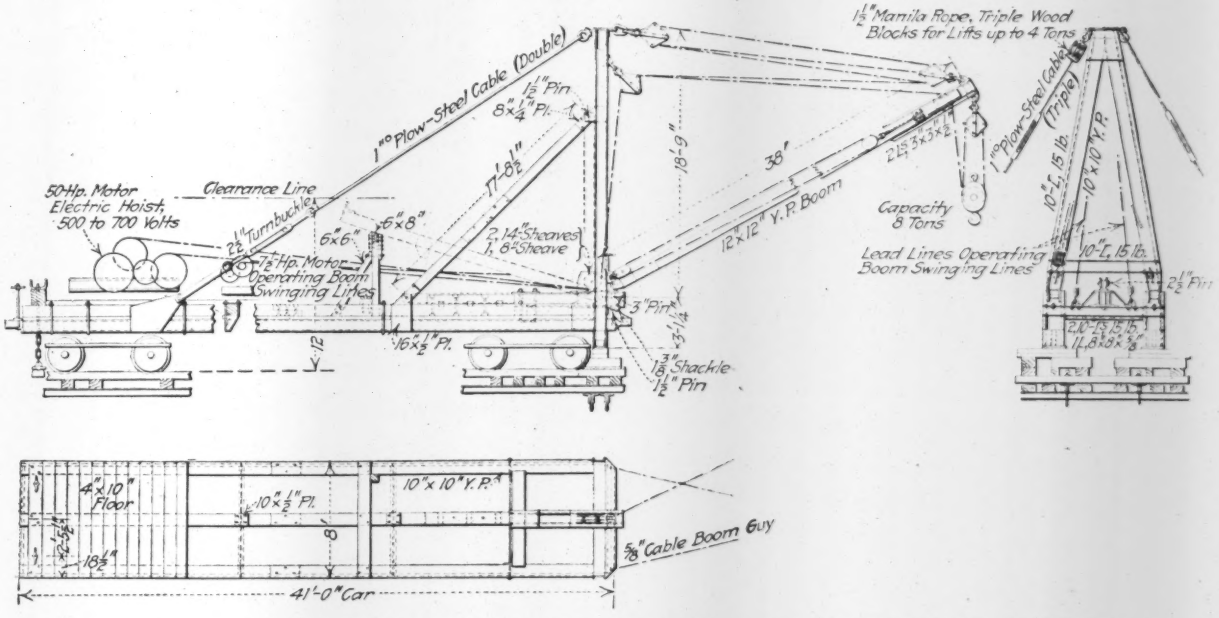


FIG. 2. DERRICK CAR USED IN NEW YORK ELEVATED THIRD-TRACKING, SNARE & TRIEST CONTRACT

(Designed for working load of 8 tons plus 25% for impact with boom out 36 ft. and offside 40° from longitudinal axis of car. Before swinging boom or raising load, side guys must be fastened to existing structure, rear track clamps secured to track or track-stringers, and posts at front of car blocked as indicated)

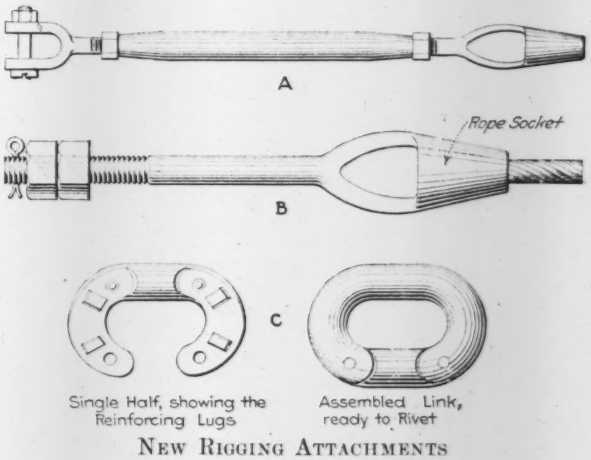
Stream Gaging in New England by the U. S. Geological Survey is hereafter to be carried on from a district office at Boston in charge of Charles H. Pierce. The States of Massachusetts, Maine and Vermont will coöperate in the stream-gaging work of this season.

Three New Devices for Rigging

The socket-turnbuckle shown at *A*, in the drawing at the bottom of this column, is used on elevator and construction work and also in ship rigging. Its special and patented feature is the combination in one piece of the rope socket and the turnbuckle end.

The socket-bolt *B* is for use on hoisting ropes and combines the rope socket with a shank for lifting purposes.

The splice-link for chains *C* is made in two pieces that are double-locked when fitted together. The link cannot straighten and shear off the connecting pins when under heavy strain, as the stress is distributed over the four interlocking lugs. The chain can be spliced very quickly with this link, and only a hand hammer is required to clinch the rivets.

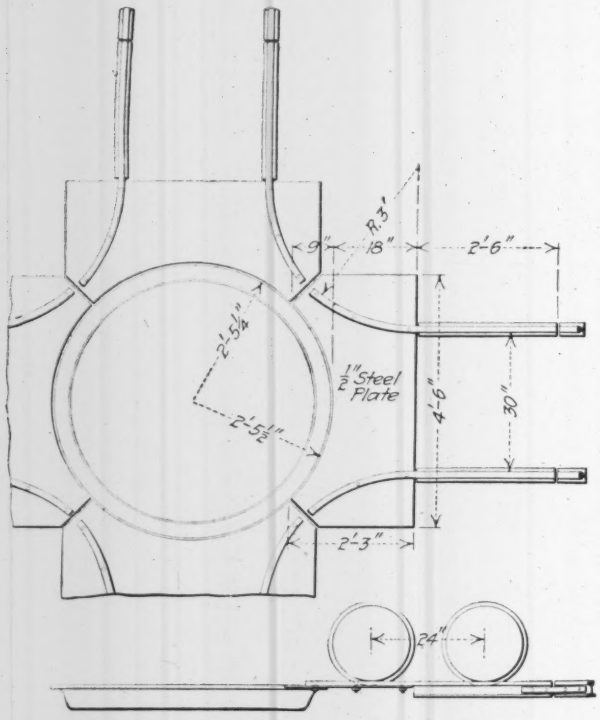


NEW RIGGING ATTACHMENTS

These three devices are drop forgings and are manufactured by the Marine Hardware Equipment Co., South Portland, Me.

Improved Turntable for Contractor's Dump Cars

The mucking tracks at the Bayonne shaft of the Newark Bay siphon tunnel for the Passaic Valley Sewer include several turntables, on account of the special track arrangement rendered necessary by certain shaft conditions. In the ordinary operation of turntables on industrial tracks the difficulty and loss of time in matching the tracks on the turntable with the fixed tracks are apt to cause frequent derailment, which means serious delay to the whole work. Great simplification of work at the turntable is secured on this job by a novel arrangement of the turntable approach tracks devised by R. H. Keays, Engineer



IMPROVED TURNTABLE FOR DUMP CARS

for the contractors, the New York & New Jersey Construction Co.

The turntable approach, shown in the drawing with this article, has curved diverging track-ends at the approach, with a steel-plate apron between and around them. This apron is a trifle above the normal level of the wheel flanges, so that as the wheels mount the plate they ride on their flanges and become free from top of rail, running forward on the plate to the turntable. Coming off the turntable, the car will run on the plate into the flaring opening of the rail ends, and when the forward wheels come in contact with either rail the car is securely guided onto the track.

The plate is fastened to the rail by countersunk bolts through the rail-head, the web and base of rail being cut away.

W. Steenburgh, shaft superintendent for the contractor, says that there have been no derailments at turntables and practically none on the entire trackage in the tunnel. The latter is credited to the care observed in keeping the tracks in good line and surface, which was thought necessary in order to have the electric storage-battery locomotives operate well.

Coast and Geodetic Survey Work in 1915

An outline of the fieldwork which the U. S. Coast and Geodetic Survey will do during the coming season has been secured from E. Lester Jones, Superintendent of the Survey. The program includes some extension of the country's triangulation and precise-level network, and extensive work in hydrographic surveys, wire-drag examinations, etc., of coastal waters and channels. The growing prominence of wire-drag work is to be noted in the following summary:

TRIANGULATION

Primary triangulation will be carried from the northern limit of the transcontinental triangulation in Utah, northward and westward along the Oregon Short Line R.R. to a connection with the California-Washington arc in the vicinity of Portland, Ore., or Tacoma, Wash. This arc will cover an area which is now lacking in triangulation control (J. S. Bilby, chief of reconnoissance party; C. V. Hodgson, chief of primary triangulation party). The parties will use automobile trucks as the means of transportation from station to station. Reconnoissance for primary triangulation will be extended from the 39th parallel at Pikes Peak southward to a connection with the primary triangulation of the Texas-California arc (E. H. Pagenhart, chief).

PRECISE-LEVELS

A line of precise-levels will be run from Reno to Las Vegas, Nev., along a railroad which parallels the oblique boundary between California and Nevada. This line will furnish sea-level elevations in an area that now has a number of detached nets of leveling on independent datums (George D. Cowie, chief). Two other lines will be run from Seattle to the Canadian boundary—connecting with the Canadian precise-levels—and from Huntley to Mondak, Mont., cutting in half a loop which has a perimeter of 2700 miles (J. H. Peters, chief). Both leveling parties will use hand and motor velocipede cars as a means of transportation in the field.

HYDROGRAPHIC WORK

On account of changes in Arthur Kill channel, N. J., a revision of the hydrographic and topographic surveys will be made (Stehman Forney).

Many new wharves, docks and buildings on the Philadelphia waterfront require revision of the shore line for a new edition of the chart (E. B. Latham). Wire-drag searches will be made in the approaches to Boston harbor, partly on account of the increasing draft of vessels and the opening of the Cape Cod Canal (N. H. Heck), and in the track of vessels bound from Boston to the Cape Cod Canal (Jean H. Hawley). In Alaska, portions of Revillagigedo Channel and Clarence Strait, and Sumner Strait and Snow Passage, will be examined with the wire drag (J. A. Daniels, L. O. Colbert). Last season's work by the Daniels party in Tongass Narrows was the first use of the wire drag in Alaska.

For the Bureau of Lighthouses the position of aids to navigation in Core Sound and Boque Inlet, N. C., will be determined (E. H. Pagenhart).

Offshore hydrography along the coast of Georgia and Florida will extend the detailed surveys on this portion

of the coast to a greater distance from the shore (Steamer "Bache," R. F. Luce). The hydrography and topography of Albermarle and Croatan Sounds, N. C., will be revised on account of changes in the sand bars and in the channels (Schooner "Matchless," O. W. Ferguson). The hydrography around Sandy Hook and in the western part of Long Island Sound will be revised (Steamer "Hydrographer," F. G. Engle). The previous hydrographic surveys of the western part of Long Island Sound require careful revision to develop hidden dangers. Offshore hydrography on the Atlantic Coast will also be done (Steamer "Isis," P. C. Whitney).

The survey of the approaches to the important Kuskokwim River, Alaska, where the first charting was done last season, will be continued, to be completed as rapidly as possible (Steamer "Yukon," R. R. Lukens). Work will also continue on the survey of Shumagin Islands (Steamer "Patterson," H. C. Denson), of Prince William Sound (Steamer "Taku," G. T. Rude), of the passages west of Prince of Wales Island (Steamer "Gedney," F. H. Hardy), and of the channels near Annette Island (Steamer "McArthur," C. G. Quillian). Cook Inlet, at the entrance to Knik Arm, where the shops of the new Alaskan Railroad are to be located, will be surveyed (Steamer "Explorer," R. S. Patton).

Gravity Work

Determinations of the intensity of gravity are now being made in the Southeastern States, and will be continued later in the summer in the Middle States (J. D. Powell and C. L. Garner).

Web Reinforcement of Notched Plate-Girders, Barton St. Bridge, Pawtucket

A very unusual girder detail had to be used in the Barton St. bridge over the New York, New Haven & Hartford R.R. tracks at Pawtucket, R. I. Owing to public demands in connection with the necessity for providing stairways from the bridge roadway to the station platforms below, passageways through the girders had to be arranged for access to the stairs. Fig. 1 illustrates one of these passageways. It is directly over the supporting column at the junction of two girder spans. This location is favorable with regard to the flange stresses in the girders, but intensifies the shearing stresses.

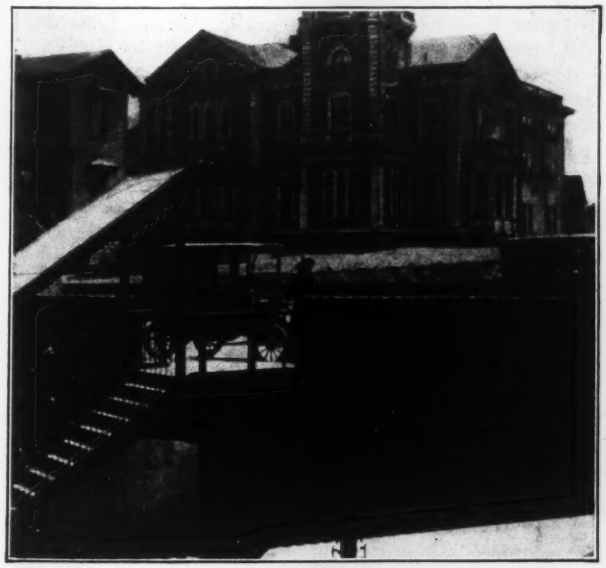


Fig. 1. Barton St. Bridge, Pawtucket, R. I.

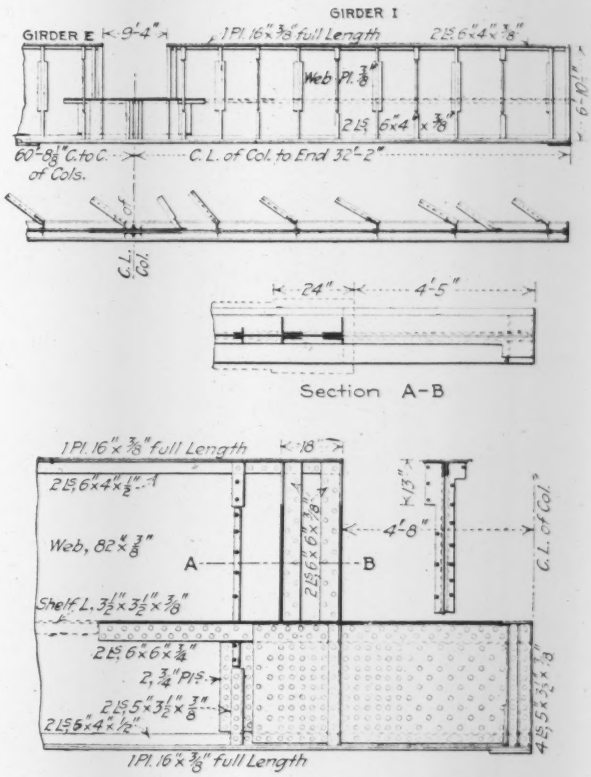


Fig. 2. Web Reinforcement of Notched Girders
(Barton St. wing of Barton-Broad St. bridge over N. Y., N. H. & H. R.R. tracks, Pawtucket, R. I.)

The girders were designed in the bridge department of the railway (Edward Gagel, Chief Engineer; W. H. Moore, Engineer of Bridges). The resident engineer on the construction work was A. L. Curtis.

which are greatest at the end of a girder. Special strengthening of the web was therefore necessary.

The detail of this provision is shown in Fig. 2. Web side-plates (¾-in.) between the flange angles and ½-in. plates over the flange angles are riveted to the ⅜-in. web. Stiffener angles are provided to transfer the shear to the end stiffeners of the full-depth section.

A Bearing Test for Foundation Soil made in Philadelphia a short time ago involved again the important question whether the test bearing plate should be at the free surface of the ground or below the surface. The foundation was to be loaded to 4 tons per sq.ft. At the bottom of the excavation, to determine whether the strata there found were capable of supporting the load, a bearing plate of 1 sq.ft. area was arranged on the ground surface, not protected from running trench water, and the platform over it was loaded without any precautions to avoid impact and vibration. The result was a large settlement, which seemed to show that the proposed loading was not safe on the strata then exposed. Before this decision was accepted, however, a further test was made under changed conditions. The bearing post was set on the bottom of a pit and the pit backfilled around it, the loading platform was braced to prevent vibration, and pig iron loading was put on carefully to avoid impact and disturbance. The full loading was applied without producing any perceptible settlement, nor did settlement occur on leaving the load standing.

Moments at Eccentric Heel-Joint of Roof Truss

The following approximate rules are given by Chas. W. Chassaing, East St. Louis, Ill., in answer to the inquiry about chord moments at an eccentric heel-joint of a roof truss (Apr 22, p. 783).

Extend the lines of center of stress in the chords until they meet, a distance a from middle of shoe. The moment of reaction R, to be resisted by bending in the chords, will be Ra, and the chord moments will be:

Top chord,

$$M_1 = \frac{Ra}{1 + \frac{I_2}{I_1}\frac{l_1^3}{l_2^3}}$$

Bottom chord,

$$M_2 = \frac{Ra}{1 + \frac{I_1}{I_2}\frac{l_2^3}{l_1^3}}$$

where the subscript 1 refers in all cases to the top chord, 2 to the bottom chord; I are the moments of inertia of the chords, and l their free bending lengths (to be taken center to center, according to the author, though between end rivets of the two gussets would be more correct).

There will be bending moments in chord and web members at other panel-points of the truss. To work these out is quite an undertaking, and no simple approximation can be made.

The rules above given will apply also to such a case as the inquirer's Fig. 2. But in that case the best solution is to introduce a web member.

H. V. Light, East Orange, N. J., uses the same method, but with l in place of l^3. He gives the following example from actual practice:

DATA—Rafter, 2 angles 6x3½x½, moment of inertia 33.18, stress 102,300 lb., panel length 5.58 ft.; bottom chord, 2 angles 5x4x⅜, moment of inertia 16.28, stress 91,500 lb., panel length 9.5 ft.; reaction 46,200 lb.; intersection of chords 5 in. outside of middle of shoe-plate.

COMPUTATION—Moment of theoretical reaction around middle of shoe-plate, 5x46,200 = 231,000 in.-lb., to be balanced by moments in the chords, in ratio of their rigidities. Taking the latter as $\frac{1}{l}$, they are 5.9 for the top chord and 1.7 for the bottom chord. Then the moment taken by the top chord will be $\frac{5.9}{5.9 + 1.7} \times 231{,}000 = 179{,}300$ in.-lb.; the bottom chord will take $\frac{1.7}{5.9 + 1.7} \times 231{,}000 = 51{,}700$ in.-lb. The extreme-fiber stresses caused by these moments are, respectively, 11,200 and 4900 lb. per sq.in., which must be added to the direct stresses in the members.

This calculation takes no account of the size of gusset-

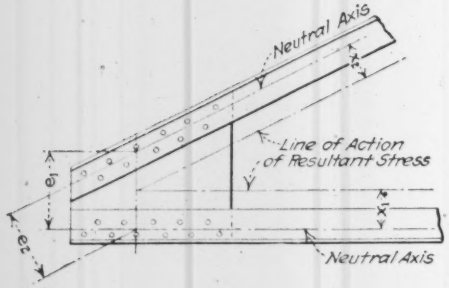


plate. It gives the same figures even when the heel gusset is extended so far as to meet the connection gussets at the first panel-point.

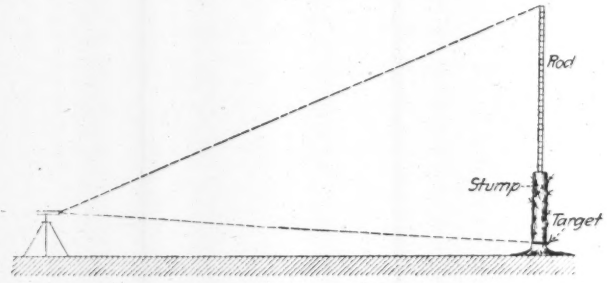
J. H. Peek, Steelton, Penn., omits the factor l in finding the rigidities of the two members; this involves the tacit assumption that the lengths of the two chords are alike, which will usually not be the case. With this exception his formulas are identical with those given above, except that the external movement is preferably computed as top-chord stress $\times e_2$, or bottom-chord stress $\times e_1$. His illustrative sketch, herewith, shows the presumed lines of resultant stress in the chords. They are shown as parallel to the chords, and while this is obviously not in accord with facts, yet the formulas and computations given above all involve this assumption.

Long Stadia Sights

In traversing with the stadia it would seem almost incredible to many even experienced railway men that distances of 3000 to 4000 ft. and longer can be read or measured by means of the stadia. But it is true. The writer frequently took sights of these lengths in exploration work on the Grand Trunk Pacific.

An ordinary 13-ft. rod when only half the wire interval is read, may be read 2600 ft. (in some transits the upper and the lower intervals are not precisely the same, but this does not matter if the mean of each is taken). In getting readings greater than this the rodman must use ingenuity. I have taken a reading of 4300 ft. across a lake and have seen a reading of practically one mile taken on a lake, from island to island.

When the sight is so long that the rod is too short to read it, the rod is placed on a tall stump (see the accom-



ROD HELD ON STUMP FOR A LONG STADIA SIGHT

panying sketch). For a target on these long distances I have found nothing better than the fieldbook covered with a white handkerchief. The target, or fieldbook, is held on the stump and moved up and down the stump according to signals received from the man at the instrument. (I have found the use of a white handkerchief covering each hand an advantage in signaling.) The rodman records the distance from the top of the rod to the target, which he measured with the rod.

For a distance of 4300 ft., or a rod-reading of 21.5 ft., 8.5 additional rod-reading is necessary with a 13-ft. rod. The stump should be at least 10 ft. high, and to hold a rod on the top of such a stump an assistant would need to stand on a limb some distance from the ground in order to hold the rod firmly and vertically, while the target man would stand on the ground below. Sometimes a slender tree in an elevated position is chosen, the top chopped off and most of the limbs, leaving one or two for the rodman to stand on. Sometimes the rod-holder can stand on an adjacent stump, and this is better.

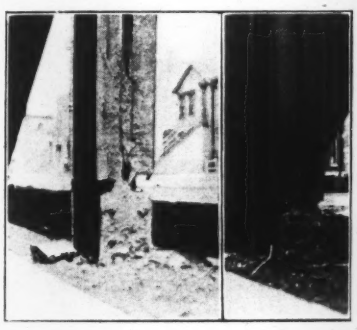
A sunshiny day is not necessary in taking long sights.

Some of the longest sights I have taken were on cloudy days, though, of course, when the sun shines on the rod it can be read much easier. It is not easy for the instrumentman to read any rod for recording purposes over a distance of 1000 ft., and no man should attempt it. When the sights are more than 1000 ft. the reading and recording should be left with the rodman.—J. A. MACDONALD, Box 83, Ottawa, Ont., Canada.

Corrosion of Stairway Columns on the Chicago Elevated Railways

On the Chicago & Oak Park Elevated Ry. (Lake Street line) several of the steel columns supporting the approach stairways have been weakened seriously by corrosion at distances of 2 to 6 in. above the ground line. One of the columns at the Campbell Avenue station is shown in the accompanying view. It is one of a pair (in a bent) and is composed of a pair of 8x2-in. channels set back to back and connected by rivets with spacers between the webs. The flanges on one side are entirely gone, while the web is affected also. The columns of the bent are connected to their shoes by gussets, the projecting parts of which are in some cases practically eaten away.

Other columns are in even worse condition. Among these are single T-head columns under the stairway platforms, built of two bent I-beams making a star section. Some of the columns are in the unpaved ground of the parkway, while others are in the concrete pavement. That the condition has been observed is indicated by the fact that in at least one case a pair of plates have been bolted to the web of a double-channel column at the weakened portion, but further repairs are badly needed. The incasing of the foot of the column in a concrete pedestal would seem to be an economical and inexpensive method of strengthening the columns and preventing future corrosion of this kind.



CORROSION AT FOOT OF STAIRWAY COLUMN ON THE CHICAGO & OAK PARK ELEVATED RY.

The columns of the elevated-railway structure proper are not affected. They are set in heavy cast-iron shoes which extend above the paving.

Mammoth New Map of the City of New York

A mammoth new map of New York City and vicinity, recently completed under the direction of Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment, includes the territory between latitudes 40° 27′ 45″ and 40° 55′ 17″, or 31.66 miles, and between longitudes 73° 41′ 30″ and 74° 16′ 30″, or 30.74 miles.

In plotting, the polyconic system was used and the range of variation in the length of 1′ of longitude from 4638 ft. at the southerly boundary to 4606 ft. at the northerly boundary was taken into account.

The entire territory is divided into 21 sheets, each representing a length of 57,708.4 ft. and a width of 25,426.3 ft. The actual size of the sheets is 8.01x3.53 ft., and the plotting is on a scale of 600 ft. to the inch.

To insure lasting qualities and permanent accuracy, the plotting was done on paper known as "Selecta," which was found specially suited to the work as to color, texture and strength. Tests of this paper made through a period of about two months showed that the extreme variation of length due to humidity and temperature changes was only 0.029 in. per ft. (expansion, 0.012 in. per ft.; shortening, 0.017 in. per ft). This variation is less than that observed for the best tracing cloth, where the changes range from 0.02 in. less to 0.04 in. more per foot of length as compared with the standard under normal conditions.

In order to transfer the map from the sheets already made, illuminated drawing tables were employed, which had working tops 4½x3½ ft., with an interior area 46x34-in. cut away and a ground-glass plate substituted. The sides and bottom of the table were boxed in and equipped with three 100-watt Mazda lamps. This made it possible to trace through two thicknesses of heavy paper with results equal to those obtained in making ordinary tracings. For assembling the sheets in order to join them properly and secure the effect of the entire map, a platform 27x28 ft. was built.

Each sheet was divided into even minutes of latitude and longitude, the lines being deeply graved into the paper to avoid possibility of erasure, and in each instance the graduation was based on a template of the same material, insuring that changes due to temperature and humidity would be identical for the entire series of sheets.

The divergence of the parallels of latitude, while amounting to 32 ft. per minute for the length of the map, or a total of 1120 ft. in the entire map, was rendered negligible by treating the problem in these small units of one minute, and it was thus possible to fit the rectangular-coördinate original to the new polyconic map, the minor adjustments required being in each case made up within the small unit areas of one minute. The basis of the plotting was a network 167 triangulation stations within the city limits and 12 stations outside the city.

To insure uniformity of street width an instrument was designed which permitted of drawing both sides of a street with one operation, gages being used for the various widths.

All the city departments rendered valuable assistance in furnishing information concerning the territory within the city, in some cases having made original surveys. In plotting the area outside the city valuable assistance was given by the Harbor Line Board, by the engineers of the various cities and villages, by the railroads, by water companies, commissioners and surveyors.

For a considerable part of New Jersey the principal reliance was placed upon the state topographical sheets (2000 ft. per in.). These sheets were enlarged by photography to the required scale in units of 1′ and such corrections applied as could be obtained from other reliable sources.

During the early stages of the work the reproduction on the desired scale was done wholly by proportional

dividers. This method was gradually superseded by the use of a pantograph of precision, but the photographic method was ultimately found to be not only most economical, but equally accurate, provided small units of area were used.

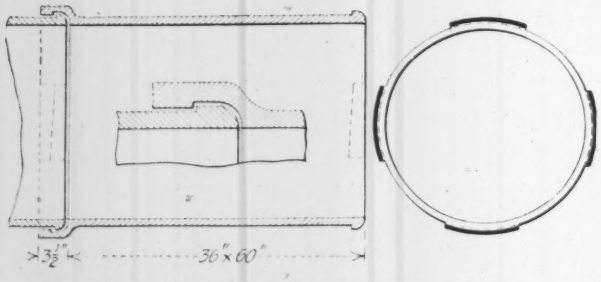
In order to avoid the expense in preparing the border, full-sized samples were made of a single section of the top and one side, and of one corner. These were reproduced for the remaining length by photolithography on the same scale.

The maximum number of men employed on the large map at any one time was 22, thus compelling a division of the force into day and night shifts, making it possible to greatly expedite the progress and at the same time to prevent the purchase of unnecessary equipment. No vacations were allowed during the entire period while the work was in progress, and the members of the permanent staff of the office, especially during the latter part of the work, voluntarily rendered overtime service to the amount of five or six hours a day.

The map as a whole has been lithographed on a scale of 2000 ft. to the inch and a mounted copy upon which certain features have been indicated in color has been sent to the Panama-Pacific Exposition as a part of the New York City exhibit.

NOTES

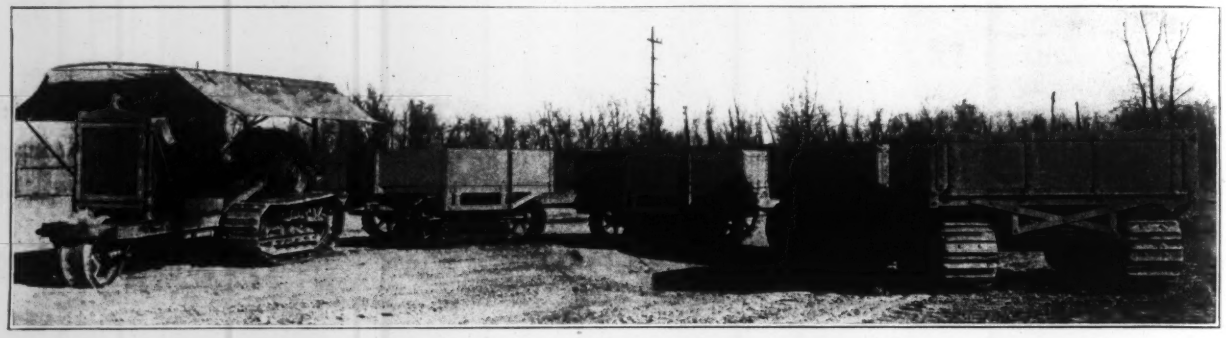
The Lock-Joint Cast-Iron Pipe for railway culverts shown in the accompanying sketch is designed to prevent separation of the joints, due to settlement of the foundation and bank. The spigot and bell have each four wedge-shaped lugs. The spigot end of the pipe is entered into the adjacent bell, and the pipe is then revolved on its axis so that the lugs engage. The pipe is made in diameters of 12 to 48 in. and in lengths



LOCK-JOINT CAST-IRON CULVERT PIPE

of 3 ft. and 5 ft., these short lengths being for convenience in railway work. If the joints are engaged but not drawn up tight, the pipe line is flexible and can be laid to a curve while the joints cannot separate. This pipe has been developed by the American Casting Co., of Birmingham, Ala.

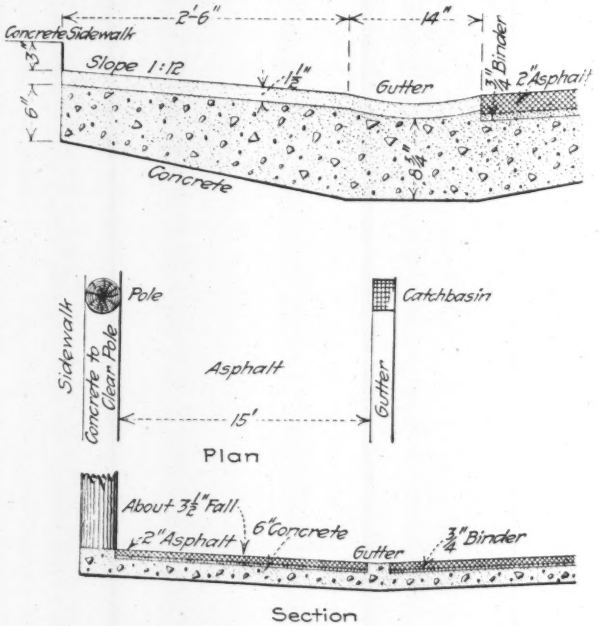
Trailer Wagons Mounted on Caterpillars—A traction train built by the Holt Manufacturing Co., of Peoria, Ill., and shown in the accompanying view, has the very unusual feature of caterpillars instead of wheels for the trailer wagons as well as for the tractor. The latter is of the three-support type, with a single wide-tired steering wheel which has ribs to give it a hold in soft ground. The caterpillars are 20 in. wide, with 2280 sq.in. of bearing surface for each



TRACTOR TRAIN WITH TRAILERS MOUNTED ON CATERPILLARS

wagon. The wagons are 11½x9 ft. over all, and 5 ft. 8¼ in. high to top of body. The inside dimensions of the body are 10 ft. 4 in. by 8 ft. 9 in. by 2 ft. The carrying capacity is about 180 cu.ft., or 10 tons, and the net weight is 11,630 lb.

Special Flat Gutter Construction—In Ottawa, Ont., street-lighting and trolley poles are sometimes placed outside the curb, and in such instances it has been the practice to move the gutter out and build a slope, or "watertable," between the curb and the gutter proper. This slope (Figs. 1 and 2) is usually built of concrete, but if it is over 5 ft. wide it is surfaced with asphalt. The lower view shows a 15-ft. "water-



SPECIAL CURB AND GUTTER CONSTRUCTION AT OTTAWA, ONT.

table" built on a 100-ft. street last year. It is claimed that this construction gives a much better surface to a business street, and in the case of very wide streets aids materially in reducing the high crowns.—Information from L. McLaren Hunter, Roadway Engineer, Ottawa, Ont.

Weights of Drawspans—Inquiry is made concerning the heaviest swingspan in the United States. The Southern Pacific draw over the Sacramento, with a gross weight of 6,400,000 lb., is quoted, with the question whether there are heavier swingspans. We have no list of weights of drawspans; if any reader can contribute data they will be appreciated.

Editorials

Physical Examination for Employees

The idea of subjecting employees and prospective employees to physical examination has been given great impetus by the passage of the various employers' liability acts. This idea has always been violently opposed by the unions, partly, it would seem, because they misconstrue its purpose. This purpose is not alone to eliminate men who are not fit to work, but—just as important—to place them in positions where there will be the greatest safety to themselves and to their fellow workers.

To some extent this is done already; railroads, for example, make sure that their enginemen are not color blind. A general and minute physical examination may not be feasible or altogether desirable, but in certain lines of work it is to the advantage of both parties that the conditions of a man's heart, lungs, etc., be determined before giving him a job that will work especially against his particular weakness or ailment.

Announcement was made on Apr. 23 that the Baltimore & Ohio R.R. had under consideration a plan for the physical examination of all candidates for employment with that company. The requirements will be similar to those exacted of applicants for service with the United States Government.

Better than a single examination is periodical examination by a physician employed either whole or part time by the employer. This idea is not especially novel; it has been known in Europe for many years. The necessity for machine inspections and repairs is unquestioned. Is it not just as important to maintain in good condition the operators of machinery?

The Low Cost of Building

A remarkable illustration of the low cost of building at the present time is afforded by the situation in the Supervising Architect's Office at Washington. Congressional appropriations provide, as is well known, a specified sum for each public building included in the sundry civil appropriation bill. The Supervising Architect's Office prepares plans for each building on the basis of this appropriation. When bids are invited for the construction, however, it has happened recently in several cases that the bids have ranged so far below the architects' estimates that it has been deemed best to withdraw the plans and specifications, and revise them to provide a slightly more expensive building.

Of course, if the work were being done by a private individual or for a corporation managed on a business basis, the contracts for the building would be let at the lower cost and a certain amount of money would be saved. In government work, however, if an appropriation is made for a post office in a town the citizens of the town and their representative in Congress are likely to make vigorous protest if the building erected costs materially less than the appropriation made for it.

This raises the question, of course, whether Congress should not make its provision for public-building erection on the basis of the size and capacity of building needed rather than by the appropriation of a lump sum for the cost. It also raises the further question whether, if the government were run on a business basis, the money spent in building post offices and custom houses would not be spent where the post-office authorities and the Treasury Department authorities advised the need was greatest, instead of distributing the appropriation according to the relative log-rolling ability of the congressmen. But that is another story.

A Broad Survey of Engineering Education

We have already noted as a matter of news, Apr. 20, 1915, the fact that the Carnegie Foundation for the Advancement of Teaching, with seven American engineering societies and the General Education Board (Rockefeller Foundation), has undertaken a comprehensive study of American engineering education and has sent out a list of questions to members in an endeavor to secure a wide and representative expression of fact and opinion from the profession—whose members are lavish with criticisms of the results now secured in our technical schools. The ideas of any practicing engineer in the country will be welcomed, and for the benefit of that considerable percentage of men who are not members of the coöperating societies the list of questions is here reprinted. Answers should be sent to C. R. Mann, Carnegie Foundation, 576 Fifth Ave., New York City. Those replying are asked to keep each answer to 75 words or less, and to give their names and addresses.

1. What are the particular points at which the work of the engineering schools is effective and successful?
2. What are the particular points at which the work of the engineering schools is least effective and successful?
3. What specific experiences illustrate the conclusions expressed in your answers to questions 1 and 2?
4. What are the most important factors in determining probable success or failure in engineering?
5. When examining a candidate for a prospective job, what sort of information is best calculated to assist in judging his fitness and probable success? Give samples.
6. What sort of work, what specific jobs, what kind of experiences are most effective in testing a man for fitness and probable success in engineering? Give samples.
7. Have you ever found a knowledge of either French, German or Spanish essential to your professional career?
8. Should a reading knowledge of one of the modern languages be required of every engineer? Why?
9. Make specific suggestions for the improvement and strengthening of engineering schools.

A word may be pertinent as to the scope and method of the Carnegie Foundation's study. Other questions are being submitted to teachers of engineering and a close first-hand study is being made of methods and results in the various technical schools of the country. Practical tests for engineering aptitudes are being tried out. The result, it is expected, will be a mass of information which will yield some concrete conclusions on the best aims for

engineering courses, on the best methods of selecting apt candidates, on better foundation training and on the organization and equipment needed. The Foundation hopes that markedly successful efforts in various lines can thus be pointed out and the elements of their success analyzed so that they may be made available for any school desirous of giving an engineering training the best possible under its local conditions.

Can the American Water Works Association Find Itself?

From time to time the American Water Works Association tries to find itself. It made the attempt at its annual meeting at Cincinnati last week.

In the thirty-five years of its existence the Association has several times lost about all of its psychic self that it had previously found. With that loss went membership, financial strength, and prestige as an association. By arduous work on the part of a few the Association has recently forged ahead. It now has a much larger membership than ever before; it is financially sound at present and may remain so if it does not become over-ambitious; it has established a useful quarterly *Journal;* it is rapidly forming geographical and technical sections; it has done much good committee work of late, although it is slowing up in that field; through the Water-Works Manufacturers' Association, the associate members have been put on a dignified and useful footing.

Notwithstanding all this gain, the Association has not yet wholly found itself. It has cast off much of the levity and all of the semi-official sanction of dissipation which so nearly wrecked it at the age of twenty-one. It has abandoned the financial looseness and happy-go-lucky customs which sapped its strength at from twenty-five to thirty years of age. But it has not yet decided whether it wants to be a united brotherhood of water-works superintendents or a technical society.

Many of the members appear to feel that in adopting more businesslike methods of electing officers and in curtailing the frolic of choosing the next meeting place they have lost some of their vested rights. Many, too, seem inclined to resent the filling of so many of the offices of the Association with engineers and other technical men—forgetting that much, if not most, of the recent growth of the Association is due to the consulting engineers, chemists and bacteriologists.

Perhaps the greatest danger immediately ahead of the Association is over-ambitious attempts at expansion. At the worst of its second period of financial straits there was a strong demand for the establishment of permanent headquarters and a well-paid full-time secretary. Then, as now, these things are financially impracticable.

Another ambition that seems unlikely of realization for a considerable period is the absorption or affiliation of all the other water-works associations of the country. Before the American Water Works Association can attain this object it must find itself. The rival which it has at last outdistanced in membership found itself long ago. The New England Water Works Association has no uncertainty as to whether it is a fraternal or a technical organization. It knows that it combines in one many of the best features of both. It knows how to give honors to, and how to get work from, both the "practical" superintendent and the professional man.

It seems necessary to say that many who keyed themselves up to the high note of coöperation in a single great water-works association sounded in President Earl's opening address at the Cincinnati convention last week, lost hope for an early realization of that ideal as the convention went on. Besides murmurs of discontent, the proceedings dragged. Neither the profession nor the "practical" men were up to their previous level in the committee reports and the discussion of papers.

It seems necessary also to say that unless the American Water Works Association finds itself it may find, instead, that it has lost many of its ablest and hardest-working members—as it came so near doing a few years ago. Then there would still be two national water-works associations, but they would be farther apart than now in aim and in membership.

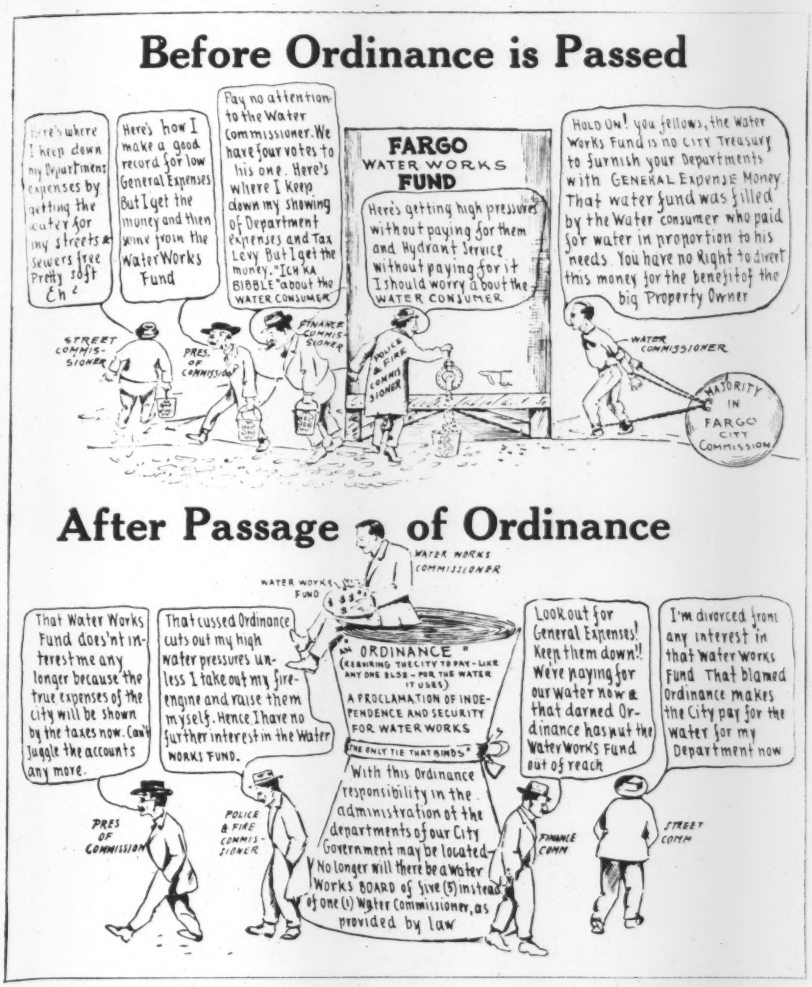
Go to it then! Find yourself, American Water Works Association! It will be well worth while—even though the New England Water Works Association persistently refuses to be more than a sister.

Water-Works Charges and Depreciation at Fargo

A root-and-branch policy for meeting the expenses of operation, maintenance and depreciation of the water-works of Fargo, N. D., was adopted on Apr. 6, 1915, by an initiative ordinance vote of 872 to 554. In brief, the ordinance provides that the cost of water-service for extinguishing fires and for all other public purposes shall be met by the proceeds of a uniform tax levy; that the public and private water rates shall be sufficient to meet depreciation; that the hydrant rentals and rates to private consumers shall be paid into a water-works fund and then appropriated from that fund for operation, maintenance and depreciation; and that the depreciation fund may be used for extensions and improvements and charged to capital account, or else may be invested and the income added to the depreciation fund, but that in no case shall the depreciation fund be used except as just stated.

All this is as rational as it is rare for a municipal water-works—although a number of such works aim to follow the same general principles as are laid down in the ordinance in mandatory form.

The detailed method for determining hydrant rentals prescribed in the ordinance is not as rational as the main principles already outlined. Minimum hydrant rates varying with pressure are stipulated for water used to extinguish fires. To these are to be added $20 per hydrant for water supplied for all other purposes at a pressure of not less than 40 lb. per sq.in., $3 per hydrant (with meter attached) for the private use of water from fire hydrants, and $5 per hydrant for the use of water for public construction purposes (with or without meters). Three rates for fire protection are named: $24 per hydrant if a pressure of 50 lb. or less is required; $36 for a pressure of 51 to 75 lb.; and $48 for a pressure of 76 to 100 lb. From the wording of the ordinance and from discussion in the local press it appears that the three classes of pressure are what may be termed conjectural rather than topographical; or more plainly, that the city authorities had not decided when the ordinance was drafted what pressure would finally be maintained


Before Ordinance is Passed
FARGO WATER WORKS FUND
Here's where I keep down my Department expenses by getting the water for my streets & sewers free Pretty soft Eh?
Here's how I make a good record for low General Expenses But I get the money and then some from the Water Works Fund
Pay no attention to the Water Commissioner. We have four votes to his one. Here's where I keep down my showing of Department expenses and Tax Levy But I get the money. "Ich Ka BIBBLE" about the WATER CONSUMER
Here's getting high pressures without paying for them and Hydrant Service without paying for it I should worry about the WATER CONSUMER
Hold On! you fellows, the Water Works Fund is no CITY Treasury to furnish your Departments with GENERAL EXPENSE Money That water fund was filled by the Water consumer who paid for water in proportion to his needs You have no Right to divert this money for the benefit of the big Property Owner
STREET COMMISSIONER
PRES. OF COMMISSION
FINANCE COMMISSIONER
POLICE & FIRE COMMISSIONER
WATER COMMISSIONER
MAJORITY IN FARGO CITY COMMISSION
After Passage of Ordinance
WATER WORKS COMMISSIONER
WATER WORKS FUND
That Water Works Fund does'nt interest me any longer because the true expenses of the city will be shown by the taxes now. Can't juggle the accounts any more.
That cussed Ordinance cuts out my high water pressures unless I take out my fire-engine and raise them myself. Hence I have no further interest in the Water WORKS FUND.
"ORDINANCE" (REQUIRING THE CITY TO PAY - LIKE ANY ONE ELSE - FOR THE WATER IT USES) A PROCLAMATION OF INDEPENDENCE AND SECURITY FOR WATER WORKS
"THE ONLY TIE THAT BINDS"
With this Ordinance responsibility in the administration of the departments of our City Government may be located. No longer will there be a Water Works BOARD of five (5) instead of one (1) Water Commissioner, as provided by law
Look out for General Expenses! Keep them down!! We're paying for our water now & that darned Ordinance has put the Water Works Fund out of reach
I'm divorced from any interest in that Water Works Fund That blamed Ordinance makes the City pay for the water for my Department now
PRES OF COMMISSION
POLICE & FIRE COMMISSIONER
FINANCE COMM
STREET COMM

CARTOONS USED IN WATER-ORDINANCE CAMPAIGN AT FARGO, N. D.

(Redrawn to accommodate space and reproduction requirements from cartoons signed "Mooney" which appeared in the Fargo "Courier-News" of Mar. 28, 1915)

throughout the city, and that the fire interests wanted a high pressure, at no charge to the fire department, while the water-works interests were determined that whatever pressure was maintained the fire department, or at least the city as a whole, should bear the expense. The net effect of the apparently complex hydrant rates is that for fire protection and all other public uses, including the right to draw water by meter from fire hydrants, the tax levy of Fargo must hereafter include a total of at least $52, or $64, or $76 for every fire hydrant in the city, dependent upon just what pressure the city finally decides to maintain.

The ordinance does not indicate, nor have we any information to show, what means except relative pressure were employed to determine the unit hydrant rentals named, nor what, if any, attempt was made to reach an economic or just apportionment of the cost of the whole water-works service between the public as a great wholesale consumer and the aggregate of the private consumers. One significant fact stands out. It is that a clean-cut fight was made between those who advocated (1) forcing the private water consumer to stand the whole expense of the water-works (and perhaps contribute to the expense of other city departments as well) and (2) making the city as a whole pay for water used for fire protection, public buildings, sewer flushing, park and street sprinkling, etc. We are glad to announce that the fair and business-like plan of dividing the burden between public and private consumers according to their respective demands won the day.

Another righteous principle that prevailed was the establishment of a separate and inviolate depreciation fund—as we hope it will prove to be in fact as well as by ordinance. Thus far, the comparatively few cities that have set up carefully devised depreciation funds have done it as a mere matter of bookkeeping. It is true that many cities do put more or less of their water-works income into extensions and improvements, but generally this is done in hit-or-miss fashion with little idea of providing against depreciation or maintaining the value of physical plant up to the liabilities carried for it.

At Fargo the depreciation allowances are not to be of the hit-or-miss kind. The ordinance provides (1) that a depreciation fund shall be started when the water-works commissioner, "after investigation and consultation with the city engineers,* shall determine that such depreciation account can be reasonably required," and (2) that "proper and adequate rates of depreciation of the several classes" of water-works property shall be determined by a board consisting of the two officials named, the superintendent of filtration and the chief engineer of the water-works power plant. The depreciation rates must be sufficient to keep the water-works, over and above maintenance, "in a state of efficiency corresponding to the progress of such water utilities generally."

The case we have reviewed is of more than usual interest because Fargo is under commission government. The majority of the commission of five refused to pass the ordinance under consideration. It was supported by the member of the commission in direct charge of the water-works, R. B. Blakemore, and at the same election he was reëlected to the commission by a vote of 1130, compared with 733 for the next highest candidate.

In the hot public campaign for the immediate adoption of the initiative ordinance the Fargo *Courier-News* published two cartoons under the heading "Political Advertising," which contain so many good points anent preying upon water-works funds and the difficulties which may beset a water-works commissioner under the commission plan of city government that we reproduce the cartoons.

*The office of city engineer is now held by F. L. Anders, to whom we are indebted for a copy of the ordinance here discussed and other related matter.

Letters to the Editor

Beaver River Surge Tank

Sir—The writer was somewhat amused by the article in your issue of Apr. 8 on "Results with a Novel Surge Tank," for the idea there employed is more precisely embodied in the so-called "Johnson Differential Regulator," as exemplified in the largest two surge tanks in America—that of the Ontario Power Co., at Niagara Falls, and that of the Salmon River Power Co., at Altmar, N. Y. (the latter described as a structure in ENGINEERING NEWS, July 16, 1914). This design is covered by basic patents applied for seven or eight years ago. There is no need of so crudely employing the differential device, since the theory has been carefully presented in papers before the American Societies of Mechanical and Civil Engineers.

R. D. JOHNSON,
R. D. Johnson & P. Wahlman.

60 Wall St., New York City, Apr. 30, 1915.

More Competition from Government Engineers

Sir—The accompanying clipping was taken from the Louisville *Courier Journal* of Apr. 26:

GOVERNMENT ENGINEER TO TAME PANTHER CREEK

Owensboro, Ky., April 25.—(Special.)—Mayor J. H. Hickman has returned from Washington, where, with the assistance of Senator James, he secured assurance from the reclamation department that an engineer would be sent to Owensboro on May 1 to take charge of the work of straightening Panther Creek, which flows through thousands of acres of valuable farming land. The cost will be borne by the landowners affected, and will amount to about half a million dollars in the aggregate. Panther Creek overflows two or three times each year, ruining crops, and by straightening it and building levees, this trouble will be avoided in the future.

The writer became interested in the Panther Creek project several years ago, made several trips to Owensboro and did some missionary work. The landowners were very much interested until it was rumored that the Government might be induced to do the preliminary work, when correspondence ceased abruptly.

We are told that the various engineering bureaus under the Federal Government exist for educational purposes and not to compete with engineers in private practice. The writer has tried to get information from the drainage department on several occasions but has never succeeded in getting any. If the Federal Government had its engineers study the various problems that engineers in private practice have not the means to study and then published this information for distribution, the profession would be benefited instead of injured.

The Government cannot handle all engineering work without greatly increasing its force, but it can do and does a great deal of work which it takes out of the hands of competent men in private practice. Usually, the choice projects are taken. Aside from the injustice to engineers, the injustice extends to all not interested in the specially favored projects. A drainage district is just as surely a corporation as the L. & N. Ry., but we have not heard that the Government has ever sent a lawyer to Kentucky to take charge of the legal work of that or any other corporation.

The writer is very much opposed to the handling of any engineering work by the Federal Government engineers, excepting experimental and research work. This may be a prejudiced view of the matter, but all engineers will surely agree that when the Government does engineering work a charge should be made for the work not less than the work would have cost if done by engineers in private practice.

S. F. CRECELIUS.

Louisville, Ky., Apr. 27, 1915.

Maryland Water-Supply and Sewerage Act Upheld

Sir—The law giving the Maryland State Department of Health wide powers of supervision over water-supply and sewerage facilities has been declared constitutional by the Court of Appeals, the highest court in the state.

The feature of this law allowing the Department of Health to require the installation of water-supply and sewerage systems, and that imposing the duty of raising funds for this purpose upon municipal officials, were contested by the County Commissioners of Baltimore County, who had been ordered to provide sewerage systems for several sections of that county. The Circuit Court of Baltimore County declared the state law unconstitutional as to the features mentioned, but the decision was reversed by the Court of Appeals. This court decided that it was within the police power of the state, and it was the duty of the State Board of Health, to require the establishment of water-supply and sewerage systems wherever their absence was a menace to the public health; it further decided that it was the duty of the municipal authorities to raise funds for this purpose when so ordered, and that it lay within their power to raise such funds by taxation, the assessment of benefits, or by the issuance of bonds up to 2% of the taxable basis of the county or municipality without special legislative enactment or a popular referendum.

Since the passage of the act in April, 1914, much progress has been made toward the establishment of better sanitary conditions in Maryland. The Legislature meets only once in two years, and in a number of instances municipalities have requested an order from the Department of Health to enable them to proceed without delay in providing water-supply and sewerage improvements that were pressing.

The following orders for water-supply and sewerage construction have been issued by the State Department of Health within the past year:

Chestertown—New source of water-supply and proper storage facilities.

Westernport—Purification of supply and proper storage facilities.

Perryville Water Co.—Construction of purification works.
Crisfield—Sewer construction.
Frostburg—Extension of sewerage system.
Baltimore County—Construction of sewerage system and treatment works at Arlington and Govans.
Montgomery County—Construction of sewerage system and treatment works for Little Falls Brook drainage area.

Under the state law no water-supply or sewerage construction work can be done without the approval of plans and specifications by the Department of Health and the receipt of a permit therefor. During the first year of the operation of this law, ending April, 1915, 63 permits for water-supply construction and 48 permits for sewerage construction have been issued.

ROBERT B. MORSE,
Chief Engineer, Maryland Department of Health.
Baltimore, Md., May 1, 1915.

Repairing Brick Pavements after Street Excavations

Sir—In Cleveland, with its preponderating mileage of brick streets, it has been necessary to work out careful methods for the replacement of brick paving that has been disturbed. We pride ourselves on patching these brick pavements so that their strength is unimpaired and, in many instances, so that the patch cannot be noticed with casual inspection.

Our first precaution is to have the city relay all of the disturbed pavement. Public-service corporations and other private concerns are permitted to make openings in pavements upon filing proper application. With this application must come a deposit sufficient to cover the cost of replacing the pavement. The city inspects the methods of excavation and dictates the methods of backfilling, but when it comes to the actual repaving none but the employees of my department are entrusted to do the work. The cost is deducted from the deposit, and the balance, if any, is returned to the party making the excavation.

I am a firm believer in the policy of compelling the return of all excavated earth to the trench. Only in case of rock excavation would I make an exception. It may be argued that the pipe or conduit takes up a certain amount of space and therefore a corresponding volume of earth may be left out of the trench. But my experience shows that, by tamping, more earth can always be returned to a trench than was removed from it, and the practice of requiring it all to be returned leaves no pretext for spongy backfills, which are a dangerous menace to the security of any pavement.

In replacing a brick pavement over a trench, we adhere closely to the original specifications used in constructing the pavement, leveling the subgrade and laying, successively, the concrete base, the sand cushion and the brick.

The joint of the completed patch with the original pavement must be in the original serrated pattern. In making the cut through the pavement, alternate bricks will sometimes be broken in the middle, leaving a series of broken bricks along the edge of the cut. These half bricks must be "toothed" out with a chisel. For this we use a chisel about 18 in. long. It is then possible to break joints in patching. A patch which does not dovetail into the original pavement, but leaves a long straight longitudinal joint between patch and pavement, cannot be too strongly condemned.

I may remark here that a long-handled chisel is the best instrument to use in making the original cut in a pavement. After an opening has been broken with a maul, the chisel can be used to cut and pry out each brick separately, making a cleaner opening and facilitating the patcher's job.

Matching brick for the patch is an important matter. If the color and size coincide with the original pavement, the patch will be scarcely noticeable. The brick should be carefully measured in matching for size. Where the new brick are thicker than the old ones good joints are impossible.

The proper compacting of the sand cushion presents a difficulty that is not found in new work. Sand is probably lost from the original cushion during excavation, so it is necessary not only to compress the new sand cushion in making the repair, but to force it laterally under the edges of the old pavement. For this purpose we use a form of sand rammer, consisting of an iron handle 6 ft. in length, with a rectangular head turned at an angle of 45° from the line of the handle. This compacts the sand at the edge of the cut and an ordinary wooden rammer or a narrow hand roller does the same service for the width of the patch.

Grouting must be done with care and exactness, two to four applications being swept into the joints and the brick swept clean at the last application. The remaining part of the task is precaution against disturbance while the grout is setting. The patch should be covered with 3 in. of moist sand and barricaded for a period of ten days or two weeks. It is a good extra precaution to barricade the entire street, where conditions permit, and thus avoid the jar of passing vehicles. But this is rarely possible on the ordinary busy street, so the best that we can do is to keep traffic off from the patch during the period of setting.

These were the methods used in replacing over 42,000 ft. of pavement last year. Our department deals with many kinds of pavements, and while there are others upon which superficial repairs can be made more easily and promptly, there is none in which the original strength of the pavement is more fully restored than in a brick pavement where there is due care in the workmanship and a careful selection of materials.

P. J. MASTERSON,
Superintendent of Street Repairs.
Cleveland, Ohio, Apr. 29, 1915.

NOTES AND QUERIES

In the article on the new railway terminal at Denver, Colo., published in our issue of Apr. 1, p. 630, we stated that the concrete shelters over the platform were to be built by the Unit Construction Co., of St. Louis. We have since been informed that the work will be done by the Western licensees of this company, the Van Sant-Houghton Co., of San Francisco.

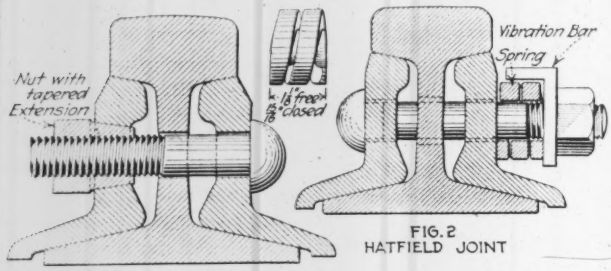
In our description of the Chicago track-elevation work of the Rock Island Lines, described in "Engineering News," Apr. 8, 1915, we stated that all the work was done by the railway company itself, except the cement-gun work and the heavy steel erection, which were done by contract. We have since learned that the concrete foundation piles were also driven by contract, the contractor being the Raymond Concrete Pile Co., of New York.

Some New Ideas in Rail Joints

The splice-bar type of rail joint is almost universal, but there are numerous modifications in its details and fastenings. We describe below three special forms of bolted splice-bar joints and also a boltless joint. All of these are in service.

The Ballou Rail Joint

The special feature is a very long nut, the main portion having an extension whose outer surface is tapered



Figs. 1 and 2. Two New Developments in Rail Joints

and fits a tapering hole in the splice bar. This gives a very long bearing for the threaded portion of the bolt and eliminates the trouble due to wear of the threaded holes in the splice bar, which can be remedied only by applying a new bar. It is stated that the nut has a sufficiently tight fit in the bar to prevent it from working loose even though no nut lock is used, while the long grip on the

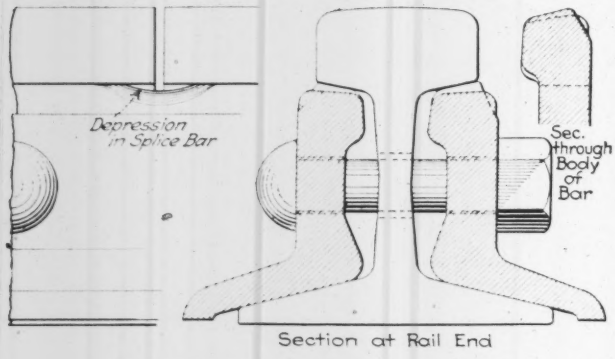


Fig. 3. The Abbott Splice Bar

bolt reduces its liability to stretch in the threaded portion. This device, shown in Fig. 1, is supplied by the Ballou Safety Rail Joint Co., of Roanoke, Va.

The Hatfield Rail Joint

On the bolts are placed heavy coiled springs, and outside of these is a long bar which engages all the bolts against which the nuts take a bearing. This "vibration bar" is designed to equalize pressure, distributing the stresses which come upon each bolt, and thus preventing the fracture of bolts and splice bars by excessive concentrated load. For the lighter sizes of rails plain splice bars and L-shaped vibration bars are used, as shown in Fig. 2. For heavy rails the splice bar has a heavy rib on the upper edge (making a channel-shaped bar) and a flat vibration bar is employed. The capacity of the springs is more than sufficient to take up the wear and elongation of the bolts. This joint is supplied by the Hatfield Rail Joint Co., of Macon, Ga.

The Abbott Splice Bar

A common trouble in rail joints is the wear and cutting of the top of the splice bars directly under the ends of the rail heads, caused by the motion of the ends of the rails. This form of wear results frequently in the fracture of the bar at its center. The rail motion includes vertical motion due to passing loads and longitudinal motion due to rail creeping and temperature changes. It affects the bar in three ways: It destroys the hard surface or rolled skin, it reduces the durability of the metal in a limited area because of the pounding from wheel loads, and it makes a nick or cut from which the fracture starts. In Europe it has been common practice to insert washers and shims between the rail head and the worn bar at this point, and special devices for taking up this wear have been invented.

In the splice bar invented and patented by F. E. Abbott, Inspecting Engineer of the Lackawanna Steel Co., Buffalo, N. Y., there is no contact with the rail heads at the extreme ends of the rails. As shown in Fig. 3, the upper surface of the bar is depressed slightly, the depression at the center being about $\frac{1}{8}$ in. on a curved length of $1\frac{1}{4}$ in. The metal rolls outward slightly as a lip or rib, so that the full cross-sectional area of the bar is retained at the depressed center portion.

The Wightman Boltless Rail Joint

A boltless rail joint in which the fastening or grip of the parts is effected by an arch and wedging action is a departure from the ordinary type of joint and is shown in Fig. 4. It consists of a pair of short and heavy angle splice bars and a short base plate of channel section. The rails, however, do not rest on the base plate, but are sup-

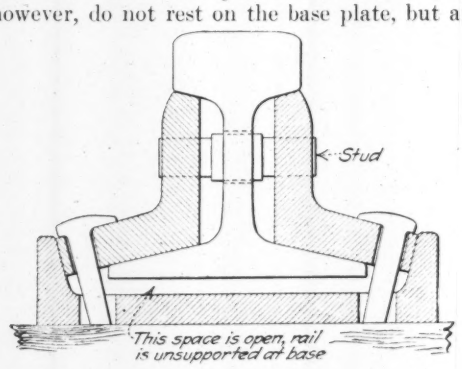


Fig. 4. The Wightman Boltless Rail Joint

ported entirely by the bearing of their heads on the splice bars, while the short flanges of these bars have a bearing against the ribs or flanges of the base plate. A single spike is put through each splice bar. Studs fitted to holes in the rails and bars hold the parts in place and limit the expansion movement.

The special feature of the joint is in the shape of the splice bars: The top bearing surface is slightly crowned longitudinally, so that the rail bearing is concentrated at the ends of the rails (this being the very opposite of the Abbott joint, noted above); the edge of the flange of each bar is crowned slightly in a longitudinal direction so that lateral pressure is concentrated at the middle of the bars

and base plate; the bottom face of the flange of each bar is recessed so that only the ends of the bar have a bearing on the rail base.

Any tendency to vertical or lateral deflection under load increases the grip and tightness of the joint. Accurate finishing and fitting of the parts is necessary, but it is believed that this can be secured while keeping the cost at or below that of a bolted splice joint. The construction is applicable also to railway frogs. This rail joint has been used on both steam and electric (interurban) railways. It is the invention of M. J. Wightman, of Seattle, Wash., and is being handled by the Railway Accessories Co., the consulting engineer for which is Hiram J. Slifer, Rookery Bldg., Chicago.

Water-Works Co-operation*

By George G. Earl†

The great purpose which organizations like the American Water Works Association are accomplishing is a constantly wider and more effective coöperation in the diffusion of knowledge looking to the improvement of the water-works practice of the day. The more men who can be induced to coöperate to this end, the better will be the results.

Other water-works associations, more or less local in character, hold meetings and publish valuable papers and reports which this association could profit by, and those associations in turn could profit equally by the papers and reports of this association.

Very few water-works officials can spare the time or money to attend several conventions each year, and relatively few can belong to two or three associations and keep up with their papers and reports, and those who have special experiences or ideas of value cannot spare the time, or for one cause or another do not care to repeat substantially the same paper to two or three associations. When standards have to be adopted or any general movement is in progress looking to the interest of the whole water-works fraternity, the multiplication of unaffiliated associations causes complication and delay.

There seems, therefore, to be every possible reason for the union of all of the water-works associations of America, with as many local branches, conventions and headquarters as can be maintained, but with one national annual convention and one common publication of all papers covering new matter of general interest. A splendid start in this direction has been made through the present very liberal conditions and regulations offered by this association for such consolidations, and two very desirable connections have already been consummated, with a third in prospect. I believe that the best interests of all water-works associations demand that this movement be continued and accelerated.

A national water-works association that included every existing organization and reached every water-works in the country could do better work, and it could, through its larger membership, make its work count for more in the obtaining of general public faith and coöperation in its standards and suggestions.

The progress which the physical side of water-works problems has made, and is making, speaks loudly and truly of the unselfish coöperation that has always existed and still exists between the allied professions whose efforts are responsible for the advance which by its very momentum must continue.

The problem which would be given the best effort of your minds is that of water rates, including service connections and the maintenance of both the services and the meters which should be placed on every one of them.

The monumental report that the Committee on the Tabulation of Water Rates and allied comparative data submitted to the convention at Philadelphia (in 1914) reflects the greatest credit upon the persistence and industry of the chairman and those members of the committee who coöperated with him in its preparation. Although the report contains information of the highest value, it tends mainly to emphasize the very wide divergence of practice and the uncertainty as to what may be considered the best practice in many of the matters that it covers.

When we examine in detail the annual reports of the water-works of the country, we find even more strongly marked this divergence of practice, and are absolutely unable to make any satisfactory comparison in almost any matter pertaining to them.

The persistent survival of flat rates for water and the illogical conditions as to payment or non-payment for fire protection, based on every conceivable measure of probable use or relative influence, are the main obstacles to any approach to better conditions. The inherent and obvious inadaptability of existing meter-rate schemes to deal fairly as between different classes of consumers is the real stumbling block in the way of the universal introduction of meters and the general reconstruction of water- and fire-service rates.

The officials of many cities see the necessity of universal metering to avoid unnecessary expenditures in extensions and operation, but they do not see how they can curtail consumption and maintain the necessary revenue without resorting to some one of the numerous expedients which are variously used to create an unfair difference in favor of one or the other of their various classes of consumers, because in existing rates one or another class of consumer has been paying too little and will strenuously oppose an increase.

The committee's tabulation shows a range of meter rates of from 5 to 50c. per 1000 gal. charged to small consumers and of from 2 to 20c. per 1000 gal. charged to large consumers. Even at 50c. it is quite possible that some of the small consumers are getting more service than they are paying for and certain that others are getting very much less. Meantime, every flagrant overcharge of one class of consumer in one place is breeding discontent, and every flagrant undercharge of the same class of consumer in another place is encouraging that discontent, and the water-works interests are being ground between the millstones of these discontents.

It is fully recognized that existing laws, contracts, customs and conditions complicate every consideration of a rapid or revolutionary change in any given case, and that not only each class of consumer whose pocket never would be touched will constitute an obstacle, but also that those who would be benefited will be suspicious and slow to recognize the benefit and to lend their coöperation.

*The larger part of the presidential address before the American Water Works Association, Cincinnati, Ohio, May 11, 1915.

†Chief Engineer Water and Sewerage Board, New Orleans, La.

For this reason, great educational work will be necessary and the approach to better conditions will be slow.

The greatest opportunity for coöperation today, which is before the various water-works associations, lies in the commanding position which would be held by a short, clear, comprehensible declaration of the general principles that should govern a proper division of the necessary total water revenue, as between the taxpayer and the water-rate payer, and as between the various water-rate payers. Such a declaration could not bring all rates suddenly to the recommended basis, but it would tend to harmonize general public sentiment.

There have been before this association many papers and discussions that bear upon various phases of this question, and there is a well-established practice as to the determination of what constitutes efficient service, and as to how to arrive at a reasonable value. There is no great divergence of opinion as to what constitutes operation and maintenance expense, or capital and depreciation charges, or a reasonable profit over and above these. It is not, therefore, the total revenue which should be secured, but rather how it should be divided between the various classes of consumers, including the taxpayer, which needs to be illuminated.

Convention of the American Water Works Association

The thirty-fifth annual convention of the American Water Works Association was held at Cincinnati, Ohio, May 10 to 14. About 350 active members were in attendance, besides 175 associate members and their representatives and 325 guests. The exhibits were many and attractive. Liberal entertainment was provided by the local committee and the Water-Works Manufacturers' Association. The papers were numerous, but drew out comparatively little discussion. The various special committees on technical subjects submitted only "progress" reports, but the committee collecting statistics on water consumption and other matters published valuable data in the March *Journal*.

Coöperation was the keynote of the presidential address by George G. Earl, Chief Engineer of the Water and Sewerage Board of New Orleans. An abstract of the address appears elsewhere in this issue.

Amendments to the Constitution

A year ago the Association adopted a new constitution. In order to break away from the electioneering, oratory and balloting which consumed so much of the time of former conventions, the new constitution provided for nominations by letter ballot, followed by election by the same means. The first year's experience under the new plan led the executive committee to suggest some minor changes. The amendment that was finally adopted, however, was one proposed by Morris R. Sherrerd, of Newark, F. W. Cappelen, of Minneapolis, and others. Briefly, it eliminates nomination by letter ballot and substitutes therefore nomination by a committee of five, chosen one each from and by five geographical districts, the choice to be made by the members attending the annual convention from each district. Additional nominations may be made by any 25 members of the Association. The election will be by ballot, as now. The five geographical divisions are: (1) New England; (2) Middle; (3) Southern; (4) Central; (5) the remainder of the United States and all territory outside the United States.

The nominating committee selected at Cincinnati was as follows: New England, Robert J. Thomas, Lowell, Mass.; Middle, Morris R. Sherrerd, Newark, N. J.; Southern, M. L. Worrel, Meridian, Miss.; "West and the Rest"—as we venture to christen District 5—H. Hymmen, Berlin, Ont.

In the lengthy discussion over this amendment the fact was brought out that for the 1915-16 officers about 200 nominating and 600 election ballots were cast, out of a membership of 1000 entitled to vote.* One or two members expressed a strong desire to return to the old practice of electing all officers on the convention floor.

The second and minor amendment to the constitution provided that the incoming, instead of the outgoing, executive committee shall appoint the Secretary-Editor.

New Officers and Next Meeting Place

The canvass of the letter ballot showed the election of the following officers: President, Nicholas S. Hill, Jr., Consulting Engineer, New York City; Vice-President, Leonard Metcalf, Consulting Engineer, Boston, Mass.; Trustees, Carleton E. Davis, Chief of the Bureau of Water, Philadelphia, and Charles H. Rust, City Engineer, Victoria, B. C.; Treasurer (reëlected) James M. Caird, Consulting Chemist and Bacteriologist, Troy, N. Y.

The practice of choosing the next meeting place by oratory and ballot on the convention floor was retained in the constitution adopted in 1914, but at the suggestion of President Earl the oratory was limited this year to three minutes per speaker, and the convention had the benefit of a report on the subject by Nicholas S. Hill, Jr. The ballot stood: New York, 142; St. Louis, 94; Detroit, 33; Richmond, 3; Erie, 1; total, 273. It may be added that on this matter the associate members vote.

Membership and Finance

The membership of all grades on the first day of the convention was 1147. This will be increased about a hundred by the affiliation of the Central States Water-Works Association as a section, which was voted for during the convention. The Executive Committee has approved a constitution for an Ohio section. An Illinois section was formed a few months ago by the affiliation of the Illinois Water-Supply Association. A New York section was formed early in 1914.

John Caulfield, for 44 years and until recently connected with the water-works of St. Paul, Minn., was made an honorary member.

A marked improvement in the financial condition of the Association—which has been desperate in times now happily past—was disclosed by the report of the treasurer. The balance on Mar. 31 was $4268, compared with $1064 a year earlier.

Reports of Special Committees

The Committee on Standard Fittings for Water Meters reported that an agreement had been reached on lengths for the smaller sizes of meters. For ⅝-in. meters the length from end to end of spud will be 7⅜ in., subject to possible change to 7½ in. For ¾-in. meters the

*It is interesting to note that in putting the new plan of nomination into effect for the first time at Cincinnati, the nominations were made by 15 persons or less in at least three of the five groups—but the notice for group-nomination meetings was necessarily short.

length will be 9 in. and for 1 in. meters, 10¾ in. The Briggs standard straight thread has been adopted, using the next size larger than the size of the meter. The committee hopes to submit a written report next year.

Papers and Discussions

The program listed 35 papers, of which 11 were printed in the March *Journal*. Only a few of the papers brought out much discussion, least of all those printed in advance.

After a whole afternoon's program of printed-in-advance papers had been gone through in short order, John W. Alvord, of Chicago, submitted a volunteer paper that saved the day. He reviewed and strongly objected to a recent New York State Court of Appeals decision in which the court ruled out from reproduction less depreciation value the cost of cutting through and replacing pavement laid after the water mains were put down. His contention was that the cost of reproduction absolutely must include this item, and that leaving it out of account is a clear case of confusing investment value with reproduction value. He urged that about half the time of courts and public-service commissions is given up to controversies over whether valuations shall be based on original or reproduction cost, and that a great service would be rendered if this point could be settled once for all. A number of engineers discussed the paper. In general, they agreed with Mr. Alvord. As put tersely by Morris Knowles, of Pittsburgh, various yardsticks may be used to determine value, but while one is being employed it should be stuck to. When through with it, consideration may be given to the question of whether the results given by that yardstick are fair.

In the course of a paper on "Franchises of Public Utilities," H. C. Hodgkins, of Syracuse, N. Y., said that 15 states have placed water-works under public-service commissions. He urged that all plans for utilities should be approved by city engineers or their representatives and that municipally owned utilities should charge rates which will yield a profit, since 70% of their consumers are not property owners and pay no taxes.

Charles P. Hoover, of Columbus, Ohio, described the process used at the water-purification works under his charge for making alum at the works. The process is saving $6000 a year on a plant investment of $12,000. Of the many steps in the commercial manufacture of alum or sulphate of alumina, most are saved at Columbus by stopping short with the syrup of alum and applying that to the water.*

A valuable paper on "Assessing the Cost of Extensions in Municipally Owned Plants" was read by D. A. Reed, of Duluth, who believes in the practice. Duluth owns both its water and gas plants. The cost of 6-in. water mains and 4-in. gas mains is assessed on frontage, at the rate of 8% per year (25% discount if all paid at once). Against this assessment there is credited one-half the annual charge for water and one-third the charge for gas.

In a paper on "The Mechanical Analysis of Sand," Philip Burgess, of Columbus, Ohio, advocated simpler standards and methods than those centering around "effective size" and "uniformity coefficient," worked up 25 years ago by Allen Hazen and widely used since then. These standards, he said, have no significance for general use (as in the analysis of sand for concrete), unnecessarily increase the cost of sand for many filter plants, and have little value for mechanical-filter sands. He advocated the grading of sand by the size of the sieve openings instead of by the size of the grain, and referred for guidance to "Technological Paper No. 42" of the United States Bureau of Standards. He also spoke of screens standardized by Professor Richards of the Massachusetts Institute of Technology in behalf of the mining engineers.

There was considerable written and oral discussion of Mr. Burgess' paper. Allen Hazen wrote that anyone who had brought out a standard 25 years ago that had been in vogue ever since ought to be willing to consider a substitute for it, but naturally wanted "to be shown." He said that "effective size" was never designed for anything but filter sand.

George W. Fuller, of New York City, said he was in sympathy with the plea for simplification, but felt that methods used 25 years should not be lightly put aside until newer methods had been tried out. Paul Hansen, of Champaign, Ill., expressed much the same idea. William B. Fuller, of New York City, J. B. Leopold, of Pittsburgh, and Mr. Jewell all took Mr. Burgess' side of the argument. The two last named urged, in effect, that most sand contractors are scared by the Hazen standards, with the result that much money is paid for freight on sand from a distance, when near-by sand equally as efficient would be used under the standard advocated by Mr. Burgess.

The convention voted for the appointment of a committee on Standard Methods of Sand Analysis, to include Allen Hazen, Philip Burgess and George W. Fuller.

Topical Discussions

Most of the subjects for topical discussion aroused little interest and brought out nothing new.

The use of lead wool for jobs where only a few joints have to be calked was reported by Secretary Diven. Several other speakers reported that contractors are averse to using lead wool instead of pig lead on regular jobs, but it was stated that in wet ground the former has given excellent results.

For packing valves one member knew nothing better than lead wool applied like any other packing material. It had been used by him ever since it came on the market. Mr. Reimer said Italian hemp packing had been used for 25 years with good results at East Orange, N. J.

A member from Kalamazoo, Mich., repeatedly took the floor against all comers in support of his own successful practice of having the water consumers pay for the meter. The weight of evidence and a saving sense of humor finally led him to acknowledge—at least by silence and smiles—that in other places it may be best for the city to own the meter. In Wisconsin the Railroad Commission has ruled that the consumer must pay for the meter. Superintendent Bohman, of Milwaukee, who has 61,000 meters to look after, deplored this ruling.

The use of 16-ft. lengths of cast-iron pipe at Meridian, Miss., had been found by Manager Morrell to be "not quite as good as the published figures." The saving on three or four carloads, including labor, lead, weight of pipe and all other charges, had been 78c. per ton of pipe.

*The process was described briefly in "Engineering News" of Dec. 17, 1914, and at greater length in the "Journal of the American Water Works Association" for March, 1915.

News of the Engineering World

The Arrowrock Dam Near Completion

The accompanying view shows the Arrowrock Dam, the highest dam in the world, as it was on Apr. 1, 1915. As is evident from the view, the dam is nearly completed, the highest section laid at that time being within 12 ft. of the crest, which is 350 ft. above bedrock. The dam is on the U. S. Reclamation Service Boise project near Boise, Idaho.

Opening of St. Louis Filtration Plant

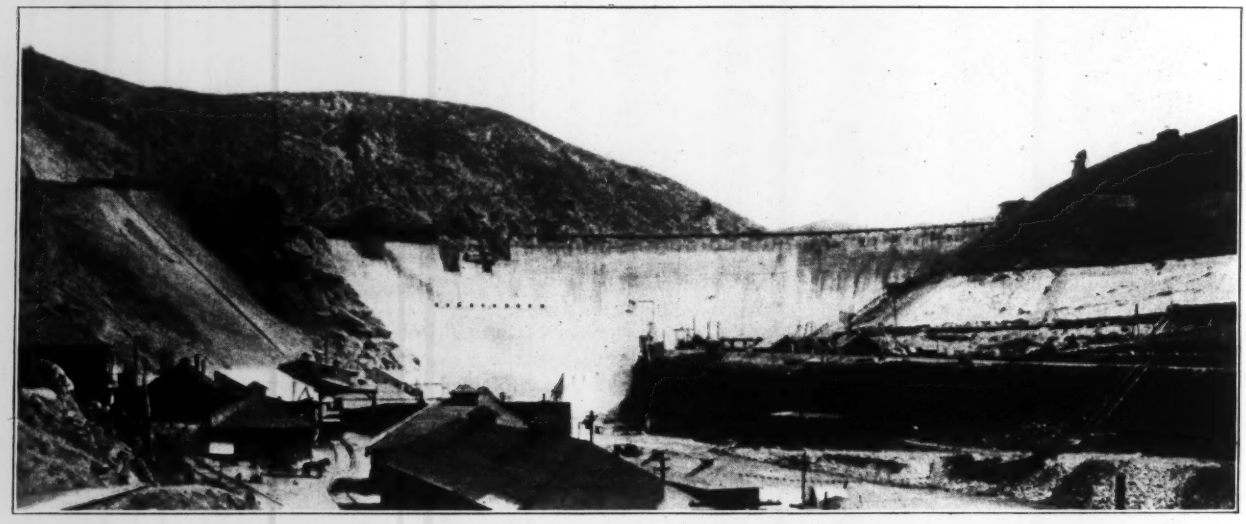
The new 160,000,000-gal. mechanical-filter plant for the water-works of St. Louis, Mo., was formally opened on May 15, with flags, fireworks and speeches. Thousands of citizens and out-of-town visitors were present, the latter embracing a number of men who went on to St. Louis from the convention of the American Water Works Association at Cincinnati. Edward E. Wall, Water Commissioner of St. Louis, was master of ceremonies. In the evening a banquet was given by the contractors for the filter plant—McCormack-Combs Construction Co. and the Pittsburgh Filter Manufacturing Co.

Fifty years ago St. Louis sent James Kirkwood, its Chief Engineer of Water-Works, to Europe to study water purification. A few years later he made his classic report on "The Filtration of River Waters." He recommended sedimentation and what is now known as slow sand filtration. The city got on for years with sedimentation only. In 1904 coagulation was introduced. In June, 1913, the construction of mechanical filters in one of the sedimentation basins, seven miles above the city, was begun.

The St. Louis water-purification plant now includes, in sequence, grit sedimentation, lime softening, coagulation with sulphate of iron, sedimentation in seven basins, color removal (at times) with sulphate of alumina, secondary sedimentation, mechanical filtration, and liquid-chlorine disinfection—a combination not dreamed of by Mr. Kirkwood fifty years ago.

A description of tests of rate controllers by Mr. Wall and Gurdon G. Black was published in our issue of May 6, 1915. The new type of venturi rate controller is used. The liquid-chlorine apparatus was supplied by the Electro Bleaching Gas Co.

At the banquet Water Commissioner Wall and Mayor Kiel spoke of the high character of the contract work. Robert J. Milligan, of the New York Continental Jewell Filtration Co., happily remarked: "If any doubts remained as to the character of the new plant they should be removed by the testimony of a disappointed bidder who had made a microscopic examination of the filters and found them perfect." M. N. Baker, of the editorial staff of ENGINEERING NEWS, said that ever since the design and construction of the plant were begun the engineering profession had believed what has now been proved true, that the St. Louis filters would be the latest model of water treatment. He wondered what Kirkwood would say if he could comment on the great differences between the works he recommended fifty years ago and those just completed. Probably he would be glad the people of St. Louis were not much interested in filtration when he made his classic report, since the plant he recommended in accordance with best knowledge of his day could not have coped successfully with the mud-laden Mississippi. The addresses closed with a few words from Messrs. Leopold and McCormack, representing the two contractor hosts, who bore testimony to the skill and coöperation of the engineers of the plant for the city.



U. S. RECLAMATION SERVICE ARROWROCK DAM, APR. 1, 1915

Concrete Paving for Levees

Concrete paving for earth levees which are exposed to violent wave action during high water is being laid by the Yazoo-Mississippi Delta Levee District, of which T. G. Dabney, Clarksdale, Miss., is Chief Engineer.

The exposed localities have heretofore been protected by a series of low terraces formed by plank revetment walls rising 3½ ft. above the levee slope, with a slope of 1 ft. in 24 from one wall to the next. These revetments are now being torn out, the normal levee slope restored and the paving laid directly on the earth.

The paving is of plain concrete (mix 1:6, cement and "river run" sand and gravel), without reinforcement or expansion joints, laid 3 in. thick and overlapping the edge of the levee crown 2 ft. It extends down the slope to a line below the zone of wave attack, with a footing at its lower edge 4 in. thick and extending 12 in. into the levee.

Reinforcement is considered unnecessary, largely because small cracks are of no importance. Expansion joints have been found in some respects to be a disadvantage, as weeds and grass quickly grow up in them. In those sections where such joints have been used it has been found necessary to close them up with grout.

Last summer one section of this paving was laid over a length of 3500 ft. and a width of 60 ft. Although without either reinforcement or expansion joints, it remains today continuous and satisfactory. At present about a mile of the paving is being placed at Friars Point, Miss., and it is proposed to put under contract 4.37 miles additional in five separate sections where wave attack is severe.

First Conference of Building Inspectors

About 25 officials of municipal building-inspection departments held a meeting at the Hotel Astor, New York City, on May 14. The call for the meeting had been issued by S. J. Williams, deputy of the Wisconsin Industrial Commission, Madison; R. P. Miller, expert to the building-code committee of the Board of Aldermen, New York City, and others. Matters of joint interest to all building officials were brought up for discussion, and practically all present entered into active discussion of a nature to show that a permanent organization would have a large field of work.

Subjects discussed were: Floor loads (recent tendency toward lowering the design load); hollow tile for outside and bearing walls (with paper by P. J. Carlin, Superintendent of Buildings, Brooklyn, N. Y., favoring the admission of this material); automatic sprinklers; inclosure of stairways.

It was decided to arrange another meeting, to be held next winter or early in the spring.

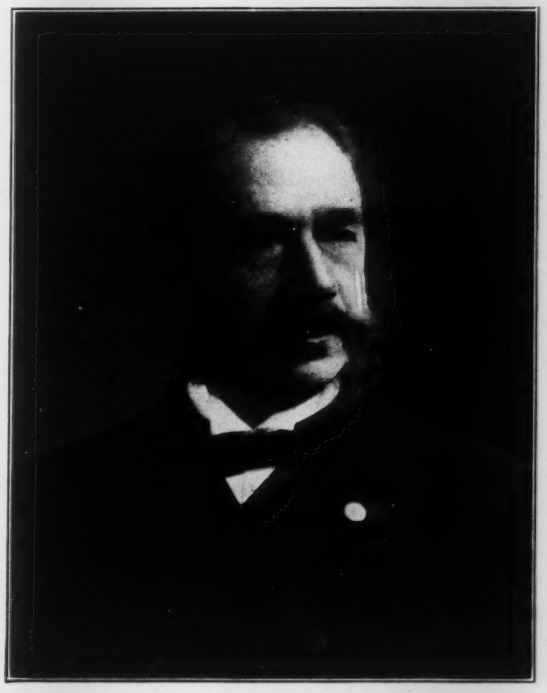
St. Paul-Minneapolis Dam

The $65,000 recently apportioned by the Federal Government for work on the combined high dam and locks in the Mississippi makes it possible to complete the work this year. Lieut.-Col. Charles S. Potter, Corps of Engineers, has received word from Washington that the $170,000 asked for for the purchase of flowage rights will not be forthcoming at present. Therefore, when the dam is completed the water will be allowed to flow through the power house and the locks will not be used until the flowage rights are obtained and the water raised above the dam. St. Paul is now at the head of navigation. The purpose of the locks was to extend navigation to Minneapolis, and in connection therewith the City of Minneapolis built a municipal wharf during the last season. The dam has been constructed with a view to installing machinery and utilizing the power. The Municipal Electric Co., composed of the Minnesota State University and the municipalities of Minneapolis and St. Paul, expects to lease the available water power and install the necessary machinery for utilizing it. This company is awaiting Congressional action as to the terms of the lease. A description of the project appeared in ENGINEERING NEWS, Nov. 12, 1914, p. 959.

John Birkinbine

John Birkinbine, Past-President of the American Institute of Mining Engineers and Chairman of the Water Supply Commission of Pennsylvania since 1905, died May 14, at his home in Philadelphia, aged 70 years. For many years he was one of the most prominent consulting engineers of this country.

He was born in Reading, Penn., Nov. 16, 1844. His father was engineer of the Philadelphia water-works. John Birkinbine's education as an engineer at the Poly-



John Birkinbine

technic College of Pennsylvania was interrupted by the Civil War, in which he served with the Union Army and afterward became assistant to his father.

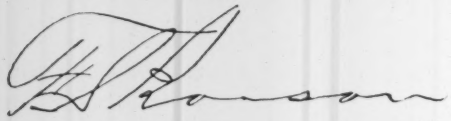
Later, he became more interested in water-power, blast-furnace plants and in mining engineering, and reported upon many mining and metallurgical industries in this

country, Canada and Mexico. He also served the United States Government as a special agent of the Eleventh and Twelfth Censuses, and for 17 years was expert on iron and manganese ores for the U. S. Geological Survey.

Mr. Birkinbine was President of the American Institute of Mining Engineers for two terms, 1891 and 1892. He was President of the Engineers' Club of Philadelphia in 1893, and for ten years, 1897 to 1907, was President of the Franklin Institute. He was an honorary member of the Canadian Mining Institute and a member of the American Society of Mechanical Engineers and of the American Society for Testing Materials. For nine years he was editor of the *Journal for Charcoal Iron Workers*, and was a contributor to many technical publications.

An Appreciation of Dr. Fred Stark Pearson*

With the sinking of the "Lusitania" there was lost a man whose name has been known among engineers and financiers the world over. That man was Fred Stark Pearson, D. Sc. He was not so well known as some less successful men nor were his great benefactions to



the people of several foreign countries or his personal characteristics so much talked about as some of his spectacular projects.

Where lesser men failed to do more than scratch at the surface, he stepped in, saw the possibilities, predicted the success of acquirement, consolidation, development and operation under American management and by American ways, won the confidence of the bankers of several countries, raised the funds, and notwithstanding the handicap of a foreign language and great distance from the source of supplies and engineering direction, found the experts to do the things properly and succeeded in establishing, at the cost of hundreds of millions of dollars, business enterprises thoroughly sound at the core and, except under war or revolutionary conditions, paying propositions. Such are the Sao Paulo Tramway L. & P. Co., the Rio de Janeiro Tramway L. & P. Co., the Sao Paulo Electric Co., all now merged with various gas and telephone companies into one great company—the Brazilian Traction L. & P. Co.; the companies in and around Mexico City and those in and around Barcelona, Spain; the great electric companies in Niagara Falls and Toronto, Ontario; the Winnipeg, Manitoba, companies; and the railroad, milling and mining companies in Northwestern Mexico.

Dr. Pearson was an American, but largely resided abroad of late, owing to the necessity of being near the financial centers of London, Paris and Brussels. He was a self-made man, but had such a thorough grounding in chemistry and electricity and such courage, inventiveness and foresight that he early in his career inspired the confidence of great financiers in street-railroad properties when electricity was still in its infancy. He was ahead of the manufacturers in all his demands, and many of the great engine, generator and motor companies owe their early development and expansion to him. In the electrification of the Boston, Brooklyn and New York street railroads he was the great dynamic force that overcame obstacles, built great power plants and electric systems of transit and set the pace and standards for the world.

Dr. Pearson became a thorough master of every subject he attacked, whether engineering, financiering, music, art or farming. In farms he possessed one of 12,000 acres in Massachusetts and New York States adjoining, and had much blooded stock and flocks and herds of every description. In music and art he was thoroughly posted, having some of the greatest treasures in his several homes in this country and abroad. He was a continuous reader in all lines of thought and practice. His travels by sea and land day and night were so extensive that few could keep his pace, yet he was constantly in touch by telegraph with the staffs of all his offices and companies and settled great financial and technical questions with the data which he always kept at his fingers' ends.

Dr. Pearson was only 54 years old, yet had compressed a whole lifetime of achievement into the last 25 years. He had gathered around him a great number of strong, competent, dependable men—engineers, managers, superintendents and experts in various lines—who are using foreign tongues in operating his properties and doing it successfully under great difficulties, and they and their families will miss his guiding and helping hand.

Dr. Pearson was a member of all the great technical societies here and abroad, but seldom was heard in any of them. His Alma Mater, Tufts College, is greatly indebted to him, as are many societies and individuals, and his place can never be filled. His enterprises will live, however, and benefit unnumbered generations to come and will be extended along the lines already shown

*Contributed by Howard P. Quick, Pearson Engineering Corporation, New York City. A brief account of Dr. Pearson's career will be found in the "Obituaries" column of last week.

to be so correct in principle and practice. It is to be regretted that many great communities which sought his advice will never see the fruition of plans which he had for their development. Many of them were postponed by the cruel war, which has now taken the great engineer.

Albert Lloyd Hopkins*

Albert Lloyd Hopkins, whose death in the sinking of the "Lusitania" was noted in our issue of last week, was born Sept. 7, 1871, at Glens Falls, New York, the son of Stephen De Forest and Elizabeth G. Hopkins. His early life was passed and his early education was received in that city and in Troy, N. Y. In 1892 he was graduated with high honors at Rensselaer Polytechnic Institute.

After a few months' work in the summer of 1892 in an architect's office in Chicago, he was appointed to a position in the Bureau of Construction and Repair, Navy Department, Washington, D. C., which position he held for about eighteen months, going to Newport News in February, 1894, as a member of the staff of Naval Constructor J. J. Woodward, U. S. N., the first superintending constructor assigned to duty at the works of the Newport News Shipbuilding & Dry Dock Co.

ALBERT LLOYD HOPKINS

In the summer of 1897 Mr. Hopkins was transferred from Naval Constructor Woodward's office and assigned to the Graduate School of Naval Architecture at the U. S. Naval Academy, Annapolis, Md., at which place he was an instructor and lecturer on naval architecture and ship construction.

At the outbreak of the Spanish-American war in April, 1898, the officers and students joined the fleet, and Mr. Hopkins was assigned to the Naval Station at Key West, Fla., the nearest station to the blockading fleet operating in Cuban waters. While there he was in charge of all the construction and repair work done for the fleet at that station. He was also active in improving the efficiency of the plant, installing much new equipment and rendering it capable of serving as a repair station for naval purposes.

It was while engaged in the work at Key West that Mr. Hopkins received from the late W. A. Post, then general superintendent of the Newport News Shipbuilding & Dry Dock Co., an offer to return to Newport News and enter the service of the company. Mr. Hopkins accepted and in August, 1898, returned to Newport News as the personal assistant of Mr. Post.

Gifted with a keen mind, he was quick to grasp the essentials of any situation. His education and training enabled him to choose unerringly the right course to pursue, and his strong will and personality enabled him to carry to its logical conclusion the course so chosen. United with these strong characteristics were an unfailing courtesy and a consideration for others which endeared him to the hearts of all his associates.

When Mr. Post was made general manager of the company in 1905, Mr. Hopkins was appointed assistant general manager, and in 1911, when Mr. Post succeeded to the presidency on account of the death of C. B. Orcutt, Mr. Hopkins was made manager.

Upon the death of Mr. Post in February, 1912, Mr. Hopkins was elected vice-president and became the chief executive officer of the company, with headquarters in New York.

It was quickly and widely recognized that an able executive was directing the affairs of the shipbuilding company. In his own profession and also among the men his profession called him to meet—bankers, lawyers and men of large business affairs—his influence was deep and ever increasing.

His election to the presidency of the company in March, 1914, was recognized as a well-earned tribute to his ability and his devotion to the interests committed to his care.

In June, 1906, Mr. Hopkins was married to Miss May Davies, of Chase City, Va., who, with their daughter, May Davies Hopkins, survives him. He is also survived by his mother, of Glens Falls, N. Y., and his brother, Charles E. Hopkins, of Hudson, N. Y.

*From a statement prepared by the Secretary of the Newport News Shipbuilding & Dry Dock Co.

Two Cars Went through a Trestle that carried the Lake Shore Electric Ry. Co. tracks above Old Woman Creek, 15 mi. from Sandusky, Ohio, on Apr. 28. The cars were laden with stone. The top of rail was 30 ft. above the creek bottom.

A Wooden Bridge Burned at Phœnixville, Penn., on May 9. The bridge, which spans the Schuylkill River, was erected in 1840; there were four spans of about 220 ft. each. The cause of the fire is not known, but it is thought to have been of incendiary origin, as earlier in the night another fire had been discovered and extinguished by the caretaker. The fire progresed so rapidly that 20 minutes after its discovery the bridge fell into the river. Six members of the local fire companies were injured.

Paving Progress in Baltimore, Md.—Since the repaving program was begun in 1911, about 90 miles of cobblestone pavements have been replaced, but about 100 miles more remain to be repaved. Besides the $1,000,000 appropriation for the

work of the Paving Commission during the current year, about $232,000 additional from the paving-tax receipts is to be expended.

A $4,500,000 Municipal Improvement Ordinance was approved by the mayor of Kansas City, Mo., on April 19 and will go to popular vote on June 1. The chief expenditures are: For sewers, $900,000; Union Station approaches, $700,000; 6th and 23d St. traffic-ways and 12th St. traffic level, $950,000; bridges and viaducts, $475,000; various park improvements, $550,000; garbage disposal, $300,000; Blue River improvement, $100,000.

The Lake Erie and Ohio River Ship Canal scheme has been before the Pennsylvania and Ohio Legislatures in the form of bills authorizing the counties in western Pennsylvania and eastern Ohio which would be tributary to the proposed canal to vote on issues of county bonds to finance its construction. The total cost of the canal is estimated at $50,000,000. Ex-Mayor Wm. A. Magee, of Pittsburgh, is Chairman of the committee which has been promoting the legislation. Both legislatures have passed the bills, but those passed in Ohio have been vetoed by Governor Willis.

Cincinnati Filtration Costs—Referring to the article on the operations of the Cincinnati water-works filtration plant for 1914, by J. W. Ellms, Superintendent, in the issue of May 6, p. 854, Mr. Ellms writes that some slight errors in the computations of cost have been discovered since the article was prepared. After correcting these errors it appears that the total cost of a million gallons of filtered water delivered into the mains in 1914 was $3.38 instead of $3.31, as stated in the published article. The cost per million gallons for operation was $2.99, and for maintenance 39c., or a total of $3.38. The cost for chemicals was $1.21. This is 46c. per million gallons less for coagulating chemicals than in the preceding year, and accounts for nearly 85% of the difference in the unit cost for 1913 and 1914.

Poor Business in the Sand-Lime Brick Field in 1914 is reported by the U. S. Geological Survey. Last year opened prosperously, but the check to building activities caused by the European War greatly reduced the demand for all building materials. In 1914 the value of the sand-lime brick produced was $1,058,512, a decrease of $179,813 as compared with 1913. Michigan continues to be the greatest producer, the value of its product constituting more than 24% of the value of the total 1914 production. Minnesota was second, and New York third. The average price per 1000 for common sand-lime brick was $5.99, as compared with $6.27 in 1913. For front brick the average was $9.08 in 1914 and $10.61 in 1913. The industry was established in the United States in 1901, when the first plant was opened at Michigan City, Ind.

Submarine "F-4" Still Submerged—Admiral Moore, Commandant of the naval station at Pearl Harbor, Hawaii, indicates in a letter just received by Secretary Daniels that considerable difficulty is being met in raising the wreck of submarine "F-4," which went down in Hawaiian waters on Mar. 29, with 21 men on board. In the operations from Apr. 21 to 26 the "F-4" was moved about 75 ft. nearer the shore and is now in shallower water. On two occasions, between these dates, cables used to tow the wreck were broken. The letter is said to state that Admiral Moore intended to send divers down to force air into the submarine to give buoyancy. This has not been attempted before because of the limited time the divers have been able to stay under water. This work was described in some detail in our issue of Apr. 22, p. 796.

The Work of the Late Frederick W. Taylor is to be continued by four of Mr. Taylor's intimate friends and associates, who have effected an organization to provide for the continuation and extension of the Taylor system of management, to carry on the correspondence which has been coming to Mr. Taylor in large volume from all parts of the world and to complete the collection of books, data, etc., supplying material for a memorial to Mr. Taylor and for a suitable biography. Those associated in this work are Carl G. Barth, Morris L. Cooke, James Mapes Dodge and H. K. Hathaway. The work is to be carried on with the aid of an advisory board of 16 members, among whom are Gen. William Crozier, U. S. A., Henry L. Gantt, Wilfred Lewis, Hans Renold, Sanford E. Thompson, Henry R. Towne and Henri Le Chatelier.

National Society for the Promotion of Industrial Education—For the purpose of determining just what kinds of industrial education will best meet the needs of her present and future workers, the City of Minneapolis has begun an exhaustive analysis of her trade and school conditions, which work it is expected will take about seven months to complete. The survey is under the direction of a committee from the National Society for the Promotion of Industrial Education. The Director of the survey is C. A. Prosser, Secretary of the Society. The investigation seeks to find to what extent the worker can progress in his job; to what extent the city's industries may give special training which they do not now provide; to what extent the schools can be a factor. The headquarters of the society is at 140 W. 42d St., N. Y. City.

Workmen's Compensation Laws, obliging employers to pay benefits to employees suffering accidental injury, without regard to the cause of the accident or negligence of the employee, have been enacted in 24 of the 48 states of the Union. The benefits paid under these laws vary widely in different states. The most important element in computing the cost of compensation is the proportion of the full wages paid while an employee suffering accident is disabled. In New Jersey and in a number of other states this proportion is 50%. In California and Wisconsin it is 65%, and in New York, Massachusetts and Ohio it is 66⅔%. For accidents resulting in permanent total disability a pension for life is allowed by New York, Ohio, West Virginia, Illinois, California and Kentucky. In New Jersey the duration of the pension is limited to eight years.

The Pan-American Financial Conference, which is to meet in Washington May 24-29, will be attended by official delegates from eighteen countries of South and Central America, some fifty or more in number. At the conclusion of the conference the delegates will be taken on special trains, as guests of the Government, to visit several of the principal cities and points of interest in the country. The itinerary of the trip is as follows: Monday, May 31, Annapolis and Baltimore; June 1 and 2, Philadelphia; June 3 and 4, Pittsburgh; June 5 and 6, St. Louis; June 7 and 8, Chicago; June 9, Detroit; June 10, Buffalo and Niagara Falls; June 11, Schenectady; June 12 and 13, Boston; June 14 and 15, New York. In each of these cities the delegates will be entertained by the city authorities and the representatives of financial and commercial organizations.

Hazard of Air-Storage Tanks in Garages—Every complete garage is equipped with an air-storage tank for quickly and conveniently inflating automobile tires. The "Travelers' Standard" calls attention to the fact that many of these tanks, in the smaller and less well-equipped garages especially, are unsafe for storing air. Ordinary hot-water kitchen tanks are in common use for storing compressed air at pressures up to and exceeding 150 lb. per sq.in. This means that on a 14-in. tank-head (at 150 lb.) the total load tending to burst the head is 23,100 lb. A welded tank is better than a riveted tank if the weld is sound; but this is impossible to determine. Cast-iron tanks are sometimes used for storing air, but this is bad practice, as cast iron is unreliable when subjected to tension. Pressure tanks should be located in accessible positions and never sunk in the ground, hidden in corners or covered with material, and they should be prevented from rusting.

The New Pennsylvania R.R. Freight Station and office building at Pittsburgh, Penn., which has been under construction for the past year, was opened on May 10. The building extends from Federal St. to Anderson St., along Canal St., in the North Side, and was completed at a cost of $1,000,000. It is a three-story structure of fireproof construction and will replace the present Anderson Street Station, which has become inadequate. The interior of the office building fronting on Federal St. is finished in chestnut, with mosaic floor and marble wainscoting. To facilitate the handling of freight between wagons, trucks and the platforms, the driveway along Canal St. has been regraded and repaved. The track layout consists of five parallel tracks, each with a capacity of 25 cars. Between tracks Nos. 3 and 4 is built an island platform extending the full length of the terminal tracks. The area of the wagon floor is about 26,000 sq.ft., while that of the track layout is about 37,000 sq.ft.

The Production of Crude Petroleum in the Southwest, a region embracing Oklahoma, Kansas, Texas and Louisiana, attained the unprecedented total of 136,943,646 bbl. in 1914, according to a bulletin just issued by the Gulf Refining Co., Pittsburgh, Penn. Excluding California's output, this amount constitutes over 72% of the entire yield of crude oil in the United States in 1914. Increased production in the Southwest, amounting to over 43,000,000 bbl., followed deeper drilling and the consequent discovery of rich pools. Oklahoma, with more than 100,000,000 bbl. to its credit, registered an increase of 52% over 1913; Texas, 32%; and Louisiana, 17%. Prices of crude oil declined sharply in the United States and in Mexico last year as a result of the accumulation in storage of many millions of barrels of surplus production. Texas and Louisiana railways using fuel oil in their locomotives and in their stationary plants consumed nearly 11,000,000 bbl. of crude petroleum and refinery residuum. This was a decrease of over 200,000 bbl., due in part to the high prices prevailing at interior points during the early months of 1914, but in greater degree to diminished traffic.

The Cost of the Telephone Investigation made by the New York Public Service Commission for the Second District, of the property and business of the New York Telephone Co., involving an investment of $84,000,000 and a yearly revenue of $10,000,000, amounted to only $43,433. A noteworthy feature of this expenditure is that while the New York Legislature last year appropriated $100,000 for the investigation, $56,567 was unexpended by the commission and was returned to the state treasury. Another noteworthy fact is that the amount paid to the special counsel of the commission in the case, Martin W. Littleton, was $7521, while the entire amount paid in salaries to the engineering and accounting forces that conducted the investigation was $31,272. It should be noted that the detailed work of appraisal, etc., was made by an appraisal committee largely of outside experts (F. B. H. Paine, chairman; H. P. Gillette, Russell Robb, H. H. Porter, M. E. Cooley, G. H. Harries, J. A. Stewart and I. J. Thorp, secretary, the last two being the only telephone employees) and a large staff. The expenses of this organization, while kept distinct from all other accounts, were paid by the New York Telephone Co., and amounted to $600,000. Of this sum $500,000 was expended on the New York City work and $100,000 about the state. The Public Service Commission checked the work of this committee by independent valuation of random items and compared the committee valuation with the company's accounts.

PERSONALS

Mr. H. C. Hawkins, recently Consulting Engineer, with offices at Oskaloosa, Iowa, has been appointed City Engineer of Oskaloosa.

Mr. Frank A. Merrill, Acting Engineer of Maintenance-of Way, has been appointed Engineer of Maintenance-of-Way of the Boston & Maine R.R.

Mr. John A. Shaw, M. Am. Inst. E. E., has been appointed General Electrical Engineer of the Canadian Pacific Ry., with headquarters at Montreal.

Mr. Charles D. Fox, of the American Electric Co., has been made Superintendent of the city lighting plant of St. Joseph, Mo., to succeed Mr. Amos L. Utz.

Mr. C. M. Fisher, formerly Assistant Engineer of Benton County, Iowa, has been appointed Engineer of Jackson County, Iowa, with offices at Maquoketa.

Mr. John W. Budd, formerly Assistant Engineer of Des Moines, Iowa, has been appointed County Engineer of Polk County, Iowa, at a salary of $2500 a year.

Mr. A. M. Hunt, M. Am. Soc. C. E., Consulting Engineer, San Francisco, has been appointed a member of the committee for the reorganization of the Western Pacific Ry.

Mr. William W. Crowley, formerly with the engineering corps of the Delaware, Lackawanna & Western R.R., has resigned to open an office for private practice at 31 West Main St., Lock Haven, Penn.

Mr. S. B. Weir has been appointed County Engineer of Taylor County, Iowa, at a salary of $1500 per year. Mr. Weir was Construction Engineer of the Iowa & Southwestern R.R. during the building of that road.

Mr. Louis P. Wolff, M. Am. Soc. C. E., Consulting Engineer, St. Paul, Minn., has been appointed a member of the Minnesota State Board of Health by Governor W. S. Hammond, to succeed Dr. C. L. Green, resigned.

Mr. David R. Cooper, M. Am. Soc. C. E., announces that he has reopened an office at 39 Cortlandt St., New York City, for the practice of hydraulic engineering, specializing in stream-flow investigations and reports on water powers.

Mr. J. W. Mavity, of Lyndon, Kan., has been appointed City Engineer of Wellington, Kan. He will have charge of the construction of a large amount of paving and sewer work soon to be undertaken by the city commissioners.

Mr. C. D. Shauver, of Cheyenne, Wyo., formerly connected with the United States Reclamation Service, has been appointed Assistant State Engineer of Wyoming. He was recently Assistant City Engineer of Sheridan, Wyo.

Mr. H. M. Stephens, formerly Superintendent of H. S. Kerbaugh, Inc., in charge of Barge Canal Terminal Contract No. 33, and the government breakwater contract at Oswego, N. Y., has been transferred to the company's Buffalo office.

Mr. Henry Bartlett, M. Am. Soc. M. E., General Mechanical Superintendent of the Boston & Maine R.R., has been appointed Chief Mechanical Engineer, having general supervision of motive power and equipment relating thereto.

Mr. R. S. Richardson, recently Assistant Superintendent of the Halifax-St. John division of the Intercolonial Ry., has been appointed Superintendent of the Fort William-Winnipeg division of the National Transcontinental Ry., with headquarters at Winnipeg.

Mr. Henry A. Varney has been appointed Town Engineer of Brookline, Mass., to succeed the late Alexis H. French, M. Am. Soc. C. E., whose death was noted in our obituary columns of May 13. Mr. Varney has been acting Town Engineer since the illness of Mr. French.

Mr. W. S. Martin, General Manager of the Denver & Rio Grande R.R. at Denver, has been appointed President of the Union Ry., of Memphis, Tenn., to succeed Mr. J. L. Lancaster, who recently resigned to become Assistant to the First Vice-President of the Texas & Pacific Ry.

Mr. O. E. Selby, Jun. Am. Soc. C. E., recently Engineer of Bridges and Structures of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed Principal Assistant Engineer, with headquarters at Cincinnati. He entered the service of the company in 1899 as Assistant Engineer.

Messrs. Joseph W. Ellms, M. Am. Soc. C. E., Consulting Sanitary Engineer; George P. Smith, formerly Chief Engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., and Clifford N. Miller, Assoc. M. Am. Soc. C. E., have organized the firm of Smith, Ellms & Miller, Consulting Engineers, with offices at 2807 Union Central Building, Cincinnati, Ohio.

Mr. C. E. Lesher, Associate Geologist of the Land-Classification Board of the United States Geological Survey, has been assigned by the Director of the Survey to take charge of the compilation of statistics of coal production published in the annual volume of the Survey on "Mineral Resources." Mr. Lesher will succeed Mr. Edward W. Parker, whose resignation will be effective July 1.

Mr. F. M. Billings, who has for several years been in Spain, in charge of the construction of the dams and canals on the Ebro Irrigation and Power Project of the Pearson Engineering Corporation, has entered into partnership with Mr. L. R. Johnson for the practice of engineering under the firm name of the Billings-Johnson Engineering Co., with offices at 652 Spreckels Building, San Diego, Calif.

OBITUARY

Joseph B. Gerker, a civil engineer of the Southern Pacific Ry., died at St. Augustine, Fla., on May 9. He was 43 years of age.

James W. Gill, a consulting engineer of St. Louis, Mo., died on May 5 from the effects of a fall from the roof of his home. A widow survives him.

Philip Mirtz, Assistant Chief Engineer of the Equipment Department of the New York Central & Hudson River R.R., died in New York on May 11, after a brief illness. He was in his 32nd year.

Joseph Rielle, M. Can. Soc. C. E., who for 60 years had practiced civil engineering in Montreal, died on May 9 at 81 years of age. He was at one time Assistant Engineer for the Montreal Harbor Commissioners and was formerly Vice-President of the Pontiac Pacific Junction Ry.

J. F. Deppe, who after 20 years of service as a civil engineer with the Mississippi River Commission, was recently appointed Senior Engineer, to succeed the late Thomas Middleton, died at his home in St. Louis, Mo., on May 11, aged 57 years. A widow and three children survive him.

Henry Clay Derrick, M. Am. Soc. C. E., died at his home in Houston, Va., on May 9, in his 84th year. He was born in Washington, D. C., in 1832 and was educated at Bolmar's Academy, West Chester, Penn. He began his career as an engineer on the Richmond & Danville R.R. in 1851 and was U. S. District Surveyor for Kansas and Nebraska from 1855 to 1858 and Assistant Engineer of the U. S. Armory at Harper's Ferry from 1858 to 1861. He served as Captain of Engineers in the Confederate Army, in Northern Virginia, from 1861 to 1865. He was appointed Lieut.-Colonel of Engineers of the Egyptian Army, on the Staff of Gen. C. P. Stone, and served as Chief Engineer in the Abyssinian Campaign from 1875 to 1878, receiving the decoration of the order of Medjidieh from the Khedive Ismail for his services. Colonel Derrick was at various times Chief Engineer of the Danville & New River, the Chesapeake & Ohio, the Richmond & Allegheny, the Louisville, New Orleans & Texas and the Lehigh & Delaware railroads, and he was Principal Assistant Engineer of the Roanoke & Southern Ry. A widow and five children survive him.

ENGINEERING SOCIETIES

COMING MEETINGS

MASTER BOILER MAKERS' ASSOCIATION.
May 25-28. Annual meeting in Chicago. Secy., H. D. Vought, 95 Liberty St., New York City.

AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION.

June 3-4. Annual convention at Bellevue-Stratford, Philadelphia, Penn. Secy., F. D. Mitchell, 1510 Woolworth Bldg., New York City.

NATIONAL DISTRICT HEATING ASSOCIATION.
June 1-3. Annual convention at Hotel Sherman, Chicago. Secy., B. L. Gaskill.

NATIONAL CONFERENCE ON CITY PLANNING.
June 7-9. National Conference in Detroit, Mich. Secy., Flavel Shurtleff, 19 Congress St., Boston, Mass.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 9-11. Annual convention in Atlantic City. Secy., Jos. M. Taylor, Karpen Bldg., Chicago.

MASTER CAR BUILDERS' ASSOCIATION.
June 14-16. Annual convention in Atlantic City. Secy., Jos. M. Taylor, Karpen Bldg., Chicago.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.
June 17-18. Semi-annual meeting at Toledo. Secy., Frank E. Sanborn, Ohio State University, Columbus.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
June 22-25. Annual meeting at Iowa State College, Ames, Iowa. Secy., F. L. Bishop, University of Pittsburgh, Pittsburgh, Penn.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 22-25. Summer meeting at Buffalo, N. Y. Secy., Calvin W. Rice, 29 W. 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 22-26. Annual meeting in Atlantic City. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

Baltimore Section of the American Society of Civil Engineers—The following officers have been elected for 1915: President, Thomas D. Pitts, Principal Engineer to the Sewerage Commission; Secretary and Treasurer, C. J. Tilden; Board of Directors, J. E. Greiner, Calvin W. Hendrick, B. Powell Harrison, Benjamin T. Fendall, Mason D. Pratt, R. Keith Compton, Robert B. Morse and Henry G. Shirley.

Contractors Association of Philadelphia—General contractors in Philadelphia have recently organized under the name of the Contractors Association of Philadelphia. The Association will follow the lines of the General Contractors' Association of New York City. The headquarters are at 538 Commercial Trust Building. The rooms will be open each day and all members can be reached through the clerk, who will be in attendance. The following are the officers: President, David Peoples; Treasurer, H. W. Underwood; Secretary, R. A. Manwaring.

National Association of Manufacturers—The 20th annual convention of the National Association of Manufacturers will be held in the Waldorf-Astoria Hotel, New York City, May 25-26. Among the speakers will be ex-President Taft, whose subject will be the "Clayton Act and Other Things." At the business sessions reports will be read on fire and accident prevention, union label, immigration, uniform state laws, trademarks and copyrights, and industrial betterment. Incidental to the convention will be a unique exhibition devoted to various phases of industrial education. The headquarters of the Association are at 30 Church St., New York City.

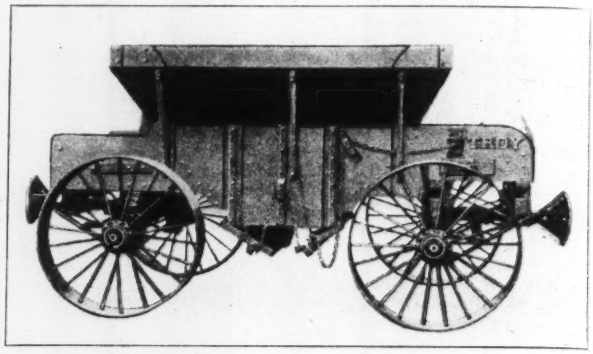
Appliances and Materials

Combined Concrete Mixer and Road Roller

A unique machine has recently been put on the market by Wettlaufer Bros., of Toronto, Ont., for contractors who wish to economize in plant investment. It is a combined steam road roller and concrete mixer. A steel truck frame supports two 5x5-in. vertical steam engines, a 15-hp. horizontal boiler, 15-cu.ft. drum mixer, tilting feed hopper, discharge spout, etc. For use as a mixer a set of small wheels is provided and when set up with them the outfit weighs about 15,000 lb. For rolling there are two rear wheels of 60-in. diameter and 17-in. face, and a front roller of 34-in. diameter and 69-in. face. The rolling speed is about 9000 ft. per hr. The entire control is centered at the operating platform, which the operator leaves only to stoke the boiler.

Trailers for Trains

The trailer wagon shown in the accompanying illustration is one of several developed by the Troy Wagon Works Co., Troy, Ohio, particularly for use in long trains behind a traction engine. The wagons have double bolsters, couplers and draw-heads with large bearing surfaces designed to maintain straight-line draft and wagon alignment, all four wheels on pivoted axles like the front wheels of a motor car, steel



TROY REVERSIBLE SPREADING TRAILER

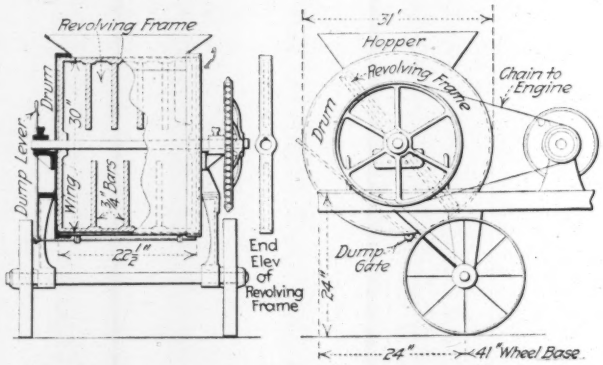
wheels with 8-in. tires and a carrying capacity of 10,000 lb., overlapping bottom doors, etc. For hauling brick, cement, etc., 10,000-lb. trucks are made, with 6x12-ft. platforms. For lumber, logs or pipe, similar trucks are made, with platforms extensible to 18 ft. length.

* * *

Mortar Mixer with Stationary Drum

The mortar mixer shown in the accompanying sketch differs from the majority of machine mixers in having the drum stationary. A shaft passing through the drum carries a rectangular cast-steel frame, from the end of which bars project toward the shaft. This frame is machined to fit the drum closely, and as it has beveled edges, it keeps the surface clean. Wings, or flanges, may be added at opposite corners of the frame, as shown by dotted lines. The shaft is driven by a chain from a countershaft driven in the same way by a gasoline engine mounted on the truck.

The materials are charged through a hopper at the top of the drum, the opening being fitted with a grating, or screen.



MORTAR MIXER WITH STATIONARY DRUM

The mortar is dumped through a hinged door, 3 in. wide, extending across the full length of the drum. The machine is built by the Mason City Mixer Co., Mason City, Iowa, and is being introduced by R. B. Clark, Jr., Monadnock Block, Chicago.

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Surveyor's Slide-Rule

A new duplex slide-rule of particular use to field engineers is being put out by Keuffel & Esser Co., of Hoboken, N. J. One face is arranged for the determination of the meridian, after direct solar observation, in three settings of the rule; besides the regular multiplication scales, there are scales of Sin. d for declination, Cos l and h for latitude and altitude, tangents and tangents inverted and azimuth natural cosines. The other face has the usual scales for general numerical work and two full-length stadia scales for computing horizontal distances and vertical heights. The rule is listed at $18.